CONSTRUCTION TRENDS

Notes on significant movements in the construction industry

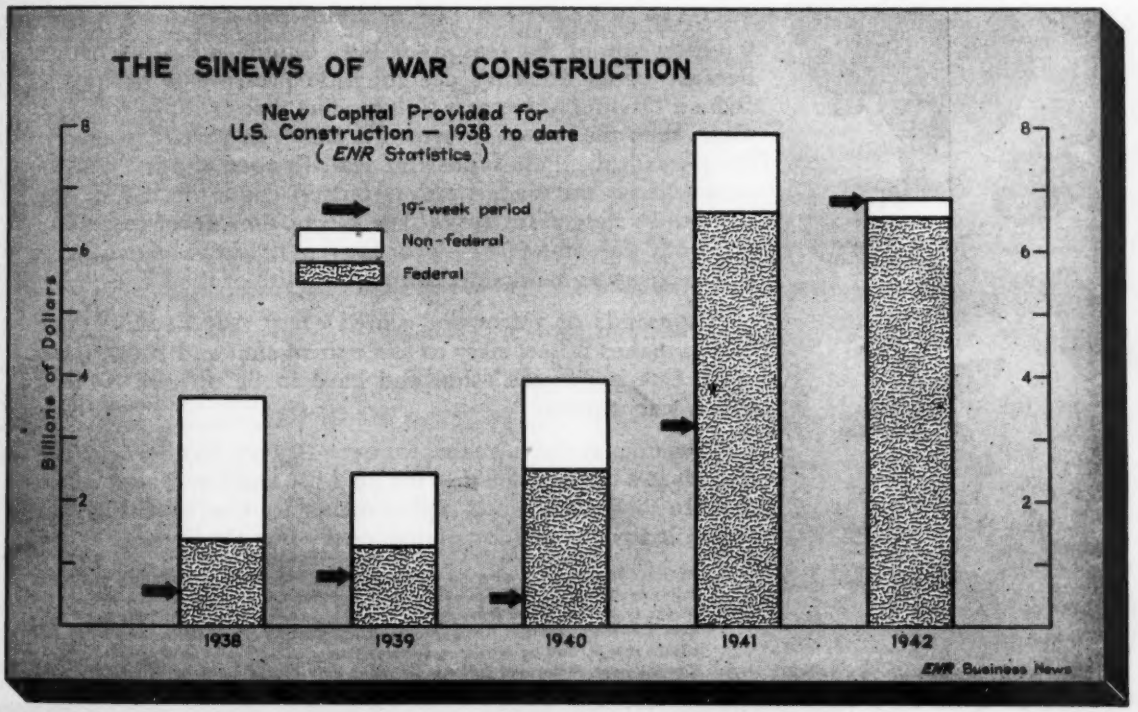
War Construction Funds Reach $16 Billions

CONSTRUCTION funds appropriated for the actual erection of war facilities in continental United States since the inception of the defense program in mid-1940 reached $16 billions with the passage of the Sixth Supplemental Defense Appropriation Act. According to *Engineering News-Record* statistics, $6.6 billions of this huge fund were appropriated in the opening nineteen weeks of 1942; $6.8 billions in 1941; and $2.5 billions in the last half of 1940. Thus, in the opening third of the current year, federal war construction funds made available have almost equaled the unprecedented high total for all of last year.

Of course, the major portion of the war construction money made available during this year was from the $19-billion Sixth Supplemental Defense Appropriation Act just signed. *ENR* estimates that of the total of $5.3 billions appropriated for construction by the Corps of Engineers that about $3.7 billions will be for structures in the United States, and the balance will be for theater-of-operations building, for construction in offshore bases, and for lease-lend facilities.

Of the funds set aside for Naval construction—$800,000,000 for Naval public works, and $220,000,000 for expansion of Naval aviation plants—it is estimated that approximately $654,000,000 will be for structures in continental United States.

Presidential approval of the $19-billion war bill brought the total federal funds appropriated since June, 1940 to $162.4 billions according to the WPB. Approximately $29 billions, or 18 percent, of this war fund was for construction. In addition to the actual erection of facilities, however, this federal financing total included land purchase; equipment and machinery; and in some cases, the initial operating contracts of manufacturing plants. Off-the-continent bases and lease-lend structures were also included.



ENGINEERING NEWS-RECORD. Published every Thursday. Vol. 128, No. 21. Price 25c per copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscriptions, domestic, Mexico, Central and South American countries $5.00 for one year, $8.00 for two years, $10.00 for three years. Canada $5.50 for one year, $9.00 for two years, $11.00 for three years. Great Britain and British possessions 54 shillings for one year, 108 shillings for three years. All other countries $9.00 for one year, $15.00 for three years. Entered as second-class matter October 29, 1936, at the Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. A. Cable Address "McGrawhill New York." Member A.B.P. Member A. B. C. Copyright 1942 by McGraw-Hill Publishing Company, Inc., James H. McGraw, Founder and Honorary Chairman; James H. McGraw, Jr., President; Howard Ehrlich, Executive Vice President; Mason Britton, Vice Chairman; B. R. Putnam, Treasurer; Joseph A. Gerardi, Secretary; J. E. Blackburn, Jr., Circulation Manager. Publication office: 99-129 North Broadway, Albany, N. Y. Editorial and Executive Offices: 330 West 42nd St., New York. Branch offices: 520 N. Michigan Ave., Chicago; 68 Post St., San Francisco; Aldwych House, Aldwych, London, W.C. 2, England; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.

TABLE OF CONTENTS—See page 49

● That's one of the reasons it lasts longer and seals better. Because of its exclusive design, little pressure is needed to make a Darling Valve seat tightly. The discs simply roll into place, then the last quarter turn expands two wedges against the discs for the tightest possible seal. To open, the first quarter turn releases the wedge action and up come the discs. And because Darling discs are *fully revolving,* they never seat twice in exactly the same place—wear is even, the valve lasts longer, a perfect seal is maintained throughout life of the valve.

Thousands of valves are ruined every year because their design makes it necessary to force them shut and break them open. Others "freeze" shut and have to be opened by heat which warps parts.

Why not use the valve that for over 40 years has been setting records in a dozen industries for long life and low maintenance cost? In these days when replacements are harder and harder to get, it pays to buy for permanence—buy Darling.

Darling offers you a quality line of longer-lasting Gate Valves. They come in Fully Revolving Parallel Seat Double Disc, also in Taper Seat—Slotted and Solid Wedge types. In service pressures up to 3000 pounds, you can get Darling Gate Valves in Cast Iron, Bronze, Forged Steel, Cast Steel, and Corrosion Resistant Alloys. Darling also manufactures Compression Type Fire Hydrants, Check Valves, Motor and Cylinder Operated Valves, and many accessories.

TRADE DARLING MARK

VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewers, Waterworks, Bridges, Highways, Streets, Dams, Foundations, Earthwork, Flood Control, Public Works, Irrigation, Canals, Railroads

McGRAW-HILL PUBLISHING COMPANY, INC.

Publication Office: 99-129 North Broadway, Albany, N. Y. • Editorial and Executive Offices: 330 West 42nd Street, New York

JOHN ABBINK, *Publisher*

WALDO G. BOWMAN, *Editor* ALBERT E. PAXTON, *Manager*

Vol. 128 MAY 21, 1942 No. 21

THIS WEEK

• Comprehensive data on building vibration characteristics has been compiled by the U. S. Coast and Geodetic Survey, and presented for the first time in a usable form for designing engineers. Information covers both buildings and elevated water tanks.

• How various types of station street deck framing and supports were constructed for the Chicago subway system by four different contractors to accomplish the same purpose is told on p. 74.

• Engineers in action are described by Col. George F. Lewis, who outlines the role of the Army engineer in combat and on the home front.

THINGS TO COME

• How one-story school buildings were built in 90 days, at a cost of $3.50 per sq. ft., including utilities, grading, and paving, by extensive use of plywood is to be told in the June 4 issue.

• Design and construction of an underground air-raid shelter to accommodate 50 people, and to withstand the impact of 100 lb. demolition bombs—also in the June 4 issue.

• Paper salvage is detrimental to incineration operation but will prove helpful in sanitary fill disposal of refuse. This is one of the findings in landfill studies that have special bearing on wartime refuse disposal, outlined in the June 4 number.

• A new method for obtaining quick and accurate comparisons of bituminous materials used in highway work, and for establishment of viscosity requirements on a sound basis, will be given in the June 4 issue.

• Procedures in mixing and placing concrete for 42,000 cast-in-place piles, 450,000 cu. yd. of structural concrete and erecting the forms that required 20,000,000 b. ft. of lumber for the War Department's new office building at Arlington, Va., will be described soon.

• An economical concrete floor design using wire in place of steel bars in precast joists for housing projects, which reduces the cost of the floor system below that of wood construction, also is scheduled.

PAGE

The Week's Events 51
Reader Comment 58
Editorials 60
Big Arms Plant Built in Congested Area 62
Operating Experience on Pioneer Windowless Plant 65
Engineers in the Army 66
Roadbuilding in the Good Old Days CHARLES T. FISHER 69
Temperature Recorded in Concrete Monolith 72
Fast Foundations in Frozen Ground 73
Chicago Subway Station Street Decking 74
Vibration Periods of Structures H. M. ENGLE 79
Concrete Pumped Downhill for a Dam CHARLES M. GLINES 83
Highway Link Across Australia 85
Steel Economy in Concrete Slabs and Columns A. J. BOASE 86
Golden Gate Bridge Movements Studied 87
Safe Jobs Save Time A. W. MEINKE 88
Patent Rights Waved on Wood Sash 90
Making Equipment Last Longer 91
How to Save Oxyacetylene 93
A Contractor's View on War Construction 94
Field and Office 95
Unit Prices 98
New Aids to the Constructor 100
New Publications 112
Manufacturers' Activities 114
Meetings 122
Men and Jobs 126

Number of copies of this issue printed: 37,140

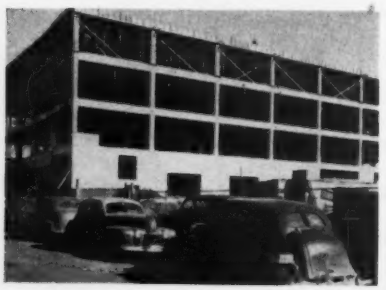
SPEED UP DEFENSE CONSTRUCTION WITH ATLAS HIGH-EARLY CEMENT!

When time must be saved on any construction project, specify Atlas High-Early cement. It's made to order for speeding up construction in winter or summer . . .

★ ★ ★

SPEED in building cantonments, defense housing, naval bases, roads, runways. Speed in building, converting and repairing defense factories. That's today's "must." And SPEED's the reason builders are specifying Atlas High-Early cement.

Specify it for any type of new concreting work, for conversion of existing plants, or for quick, lasting repairs. In actual application Atlas High-Early cement is similar to normal portland cement . . . easy to work with, requires no special equipment.



● Atlas High-Early cement saved three to four weeks' time in construction of this Appleton Electric Company building in Chicago. *Architect:* Robert C. Ostergren; *Engineers:* Smith & Brown; *Contractor:* Carl E. Erickson Co.

SAVES TIME: *Look what Atlas High-Early cement has done on these typical jobs:*

Saved 72 days on new factory.
Saved 13 days on machine tool plant addition.
Saved 12 days on foundations.
Saved 24 days in winter construction.
Saved 25 days concreting at freezing temperature.
Saved one week in finishing factory floor.
Cut one month off three-month building schedule.
After 70 hours made concrete strong enough to hold 560 tons of steel.

SAVES MONEY: *On many jobs Atlas High-Early saves money, too. For example:*

Saved $1000 in tarpaulin costs.
Saved $288 in fuel costs.
Saved two sets of forms.
Saved 20,000 ft. of lumber and 20,000 ft. of plywood.

Specify Atlas High-Early cement to speed up defense housing; to speed up new cantonments; to speed up defense industry construction; to speed up construction of administrative buildings, hospitals, warehouses, roads, runways . . . any kind of concrete work.

● Defense expansion was pushed ahead 13 days with Atlas High-Early cement at the Monarch Machine Tool Company, Sidney, Ohio. *Architect:* Schenk & Williams; *Contractor:* M. C. Ferguson.

NOW IS THE TIME to speed up rush jobs with Atlas High-Early cement. Specify it for your next job. Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York City.

. . .

OFFICES: *New York, Chicago, Philadelphia, Boston, Albany, Pittsburgh, Cleveland, Minneapolis, Duluth, Kansas City, St. Louis, Des Moines, Birmingham, Waco.*

ENR-H-42

ATLAS HIGH-EARLY CEMENT

A UNIVERSAL ATLAS PRODUCT

The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • MAY 21, 1942 • VOLUME 128 • NUMBER 21

War construction wave seen ebbing as schedules are met

End of huge building program appears in sight as WPB eases building tempo to take account of material and manpower reserves. Plants are now meeting war needs.

The construction industry has not yet reached completion of its war job, but this month the end begins to come in sight. The War Production Board has decided to ease off the tempo of expansion of new plants—a job that has accounted for about half of all war construction. The size of the job is shown by *Engineering News-Record's* construction reports for the first three months of 1942; these show that out of a total construction of $1,993,000,000, $671,000,000 or about 34 percent went into construction of manufacturing plants. The figure does not include shipyard construction.

A tremendous volume of new plants put under contract in recent months, or now on the verge of going under contract has, by and large, provided the facilities needed to meet war production schedules. This time the schedules are relatively final, and will not be doubled and redoubled as in the past.

Approaching shortages

The reason for this situation is that the country is approaching drastic shortages of both material and manpower. There is no purpose in building more fabricating plants if materials are not available for operating them, or if the men needed are in the armed forces. And mass-production munitions plants already built are proving far more productive than anyone expected. It appears, therefore, that when plants now being built come into production, it will be difficult to keep them supplied with raw material.

This does not mean that there will be no new plants built. Some additional plants must be constructed to fill out gaps and to allow for changes in emphasis from one weapon to another. But the big surge is over.

However, the limitation applies only to end-product plants—factories to build guns, tanks and planes, and shipyards. And the effort to increase facilities for expansion of raw materials will go ahead. There will be no slacking in plans for production of aluminum, magnesium, synthetic rubber, or high-octane gasoline, for example. Although there is some difference of opinion, it looks as if expansion of the steel industry would go ahead.

Some press comment has interpreted this new approach as a rather risky gamble on a short war. This does not appear to be a major factor. Rather, the curtailment of plant construction arises from the need to maintain a balance between plant capacity and basic national resources. Every country with given manpower and natural resources has a definite ceiling capacity for the production of munitions. This country, in the last five months, has been constructing plants that will provide an output just about scraping its ceiling.

It's a high ceiling, far above that of the Axis. Germany, for instance, is believed by U. S. and British experts to have been at ceiling capacity for some years; furthermore, German production probably has been falling lately.

Effect on the construction industry will show up first in a falling off in the rate of contract awards, to be expected soon. The actual volume of construction, however, will not be affected seriously until the end of the year.

Recent WPB estimates of fourteen billion dollars of construction in 1942 will still be carried out—if the industry can do the job. But another seven billion dollars or so of work, which was in the talk stage a few weeks ago, probably never will get beyond that stage. This work, of course, would not have been completed in 1942. But it would have been put under contract this year and carried over to make 1943 another record-breaker.

As it is, however, 1943 probably will not show the high levels of construction of 1941 and '42. (*ENR*, May 7, p. 757). A rough estimate for 1943 might be placed at seven to nine billion dollars.

President of Peru greets New York engineers

President Prado of Peru (second from left) responds to greetings from engineers assembled in New York for annual meeting of the New York State Society of Professional Engineers. With President Prado, left to right, are Arthur V. Sheridan, past president of the society, Edward Larson, secretary, National Society of Professional Engineers, David B. Steinman and John C. Riedel, past presidents, and Frederick H. Zurmuhlen, president of the society.

President Prado of Peru takes part in meeting of New York engineers

Peru's engineer President, on an official visit to the United States, attends meeting of New York State Society of Professional Engineers. Proceedings broadcast on short wave to South America.

High spot of the 15th annual meeting of the New York State Society of Professional Engineers was a talk by Manuel Prado, President of Peru, himself an engineer. Speaking first in English, responding to the welcome of Fred H. Zurmuhlen, president of the society, President Prado said that he brought to American engineers greetings from their fellows in Peru. These engineers, he added, hold in high esteem the scientific accomplishments of this country in which engineers have played so important a part.

The brief welcoming ceremony was followed by an international short-wave broadcast in which Frederick Mardus, consulting engineer of Staten Island, who had arranged for the visit of President Prado and his party, spoke in Spanish while introducing the Peruvian executive. He then turned over the microphone to President Prado who spoke in Spanish and at some length, stressing the importance of this nation's good neighbor policy. The president gave hearty support to steps being taken to establish closer relations between the engineers of the two Americas and expressed amazement at the magnitude of this nation's war effort as revealed to him on his visits to Detroit, Buffalo and other cities. What he saw, he said, gave him assurance of the ultimate victory of the united nations.

Engineering in Latin America

The symposium on the future engineering and economic development of Latin America in which President Prado took part was opened by G. B. Puga, technical editor of *Ingenieria Internacional*, who told briefly of the engineering career of the Peruvian President before giving rapid survey of transportation and engineering developments in South and Central America.

Resources and industries of South America were discussed by Jorge Acuna and E. A. Reinoso. Summarizing the discussion, Frederick Mardus, said that this nation's good-neighbor policy will be a material help in establishing better contact between the Americas. South America, he said, has many raw materials that we need. Better transportation facilities now being developed will aid in giving access to these resources.

Civil protection

New York's vast organization for civilian protection was described at the opening session of the convention by Irving V. A. Huie, commissioner of public works in New York City and chief of the public works emergency division of the Citizens Defense Corps. In introducing his subject, Commissioner Huie laid emphasis on the fact that civilian protection is and must be secondary to aggressive warfare, hence actual defense operations must be on a scale that will not interfere with the war effort. In the organization set up at New York, and now functioning regularly on a 24-hour basis, it has been found possible to provide most of the needed facilities from those required for the normal functioning of the city departments plus those easily obtainable from private sources. Thus the construction equipment of local contractors is assigned to supplement city-owned equipment in the "demolition batteries", emergency equipment of the public utilities is assigned to supplement equipment of the Department of Water Supply, Gas & Electricity in the "road and sewer repair batteries", and sprinklers and tree-spraying equipment of the Park Department is assigned to the "decontamination batteries". In all there are 1,600 batteries with 31,000 men assigned to specific duties.

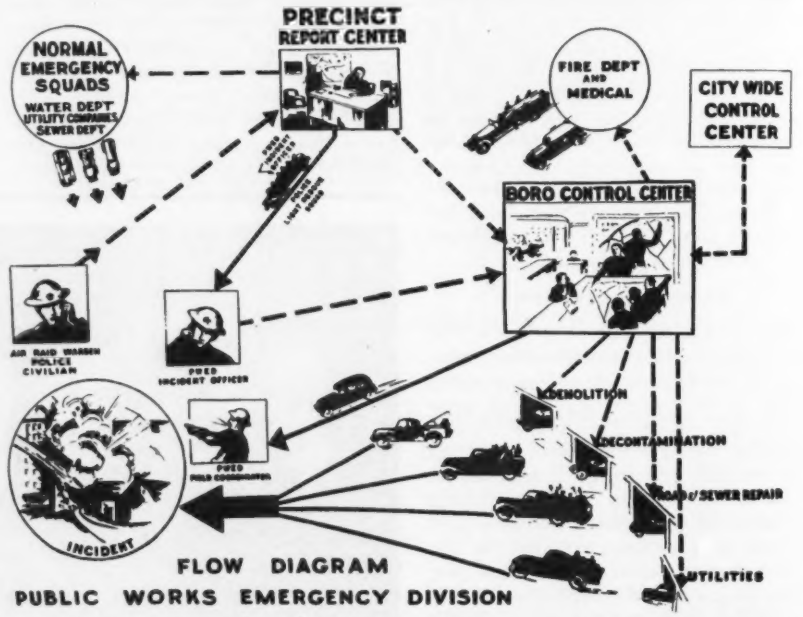
Anti-aircraft operations

Other speakers at the convention were Maj. Gen. Sanderford Jarman, head of the Anti-Aircraft Artillery Command of the Eastern Department, and Samuel G. Hibben, director of research, Westinghouse Electric & Manufacturing Co. General Jarman said that just because the average citizen does not see any evidence that targets are not protected against air attack does not mean that they lack such protection. They are well protected; and in that connection he urged his hearers to spread the word that in event of an air attack people should take cover to minimize casualties from anti-aircraft shell fragments.

Timing of blackouts

Speed in putting blackouts into effect is necessary, said Mr. Hibben, if costly slow-downs of war production and a sharp increase in traffic accidents are to be avoided.

It is Mr. Hibben's personal opinion



FLOW DIAGRAM
PUBLIC WORKS EMERGENCY DIVISION

The manner in which the public works emergency division of New York's Citizens Defense Corps will function in an emergency is shown in this diagram. The first step is for local air-raid wardens, the police or even civilians to report bomb "incidents" to the precinct report centers. That office immediately dispatches to the site its PWED incident officer, who is an engineer or architect trained in determining what action is needed. At the same time a report goes to the boro control center. As soon as the incident officer's report is received there the PWED field coordinator is dispatched to the incident if its magnitude warrants, and other needed services are advised. All action then is reported to the city-wide control center where the action of local centers is recorded.

that blackout of all lights is not essential to protection. Certain features such as rivers and shore lines cannot be concealed, hence a form of partial blackout that disrupts normal lights patterns may be more confusing than a complete blackout that emphasizes land and water formations.

Dim lights in buildings that do not throw any light above the horizontal cannot be seen, Mr. Hibben said, which is a fact not known to most air-raid wardens. Yellowish-red lamps of not over one candlepower and at least 4 ft. from an opening can be safely used. The War Department recently put out specifications for blackout lights.

Professional matters

Steps being taken to close loop-holes in the state license law that permit appointment of unlicensed engineers to positions such as city engineer were reported by D. B. Steinman, chairman of the committee in ethics and practice. As the State Education Department has declined to inaugurate legislation to correct these abuses the society instructed its legislative committee to act.

Encouraging progress toward formal recognition of "engineers-in-training" was reported by John C. Riedel, chairman of the special committee appointed to promote that change. The Department of Education has approved in principal the giving of examinations in engineering theory to young engineers immediately following graduation, and the examining board is now working out the details. Mr. Riedel said that holding the first examinations in June, 1943, now appears probable. This action by the society was inaugurated last year at the request of Metropolitan Conference of Student Chapters, American Society of Civil Engineers.

On the matter of remission of dues of men in military service, Mr. Riedel stated that the National Society of Professional Engineers at its recent annual meeting had adopted a resolution recommending to chapters of state societies that members in military service be not dropped for non-payment of dues. Approval of this plan was expressed.

New officers

James F. Fairman, assistant vice-president, Consolidated Edison Co., New York, second vice president, was elected president to succeed Frederick H. Zurmuhlen, who has served for three years. Col. Hubert E. Snyder, first vice president, was unable to accept nomination as president as he is in active service. Clarence W. Post and Joseph A. Brady were elected vice presidents. Ernest F. Fox, financial secretary, and Patrick M. Corry, treasurer were re-elected. New directors are Francis J. Laverty, Wm. F. Kavanaugh, Sheridan Black and Michael D. McDonald.

Detroit wage stabilization pattern proposed for widespread application

Building trades settlement procedure urged on President as basis for general industry stabilization program he advocates.

The pattern of wage stabilization utilized in the Detroit building trades settlement of last week (*ENR*, May 14, p 1) is being proposed to President Roosevelt as the basis of a formula for wage stabilization in industry generally. In his fireside chat on inflation control the President put forward stabilization of wages as one of the administration's economic objectives. "Stabilization", in the jargon of Washington, means something different from freezing, implies that high wages will be held level while sub-normal rates are increased. No mechanism for carrying this out has ever been set up, and most of the labor agencies in the government are working on the problem.

The Construction Labor Stabilization Board this week got together with the building trades department of the AFL on a suggestion that the Detroit settlement offered a formula that could be applied generally. Basis of the Detroit settlement was the grouping of trades into three or four levels of skill. In each skill group, the rate of the highest paid trade was adopted as standard and left unchanged, while the lower paid trades were brought up to this rate.

Details of the proposal are still confidential, but it is known to involve formulations for industry generally as well as for establishment of various skill groups for each of which wage standards could be established. Such a pattern could, of course, be applied more easily to the craft industries with well-established skills than to the mass production industries, but it is thought some sort of formula could be worked out.

Even though the proposal fails to get anywhere in industry generally, it is believed that its application to all construction may lead to a rationalized schedule of wage rates that will last over into the peace.

Through a typographical error, last week's story in *ENR* failed to make clear that Pres. John Coyne of the Building Trades Department of the AFL is a member of the Construction Stabilization Board of Review. The other members are Louis Comstock, chairman, and Maj. James T. O'Connell.

War housing material situation better

There is still little likelihood that sufficient materials will be available for housing to permit construction of many more houses of standard permanent design. But housing officials are now more inclined than they were a few weeks ago (*ENR*, April 30, p. 1) to believe that enough materials will be allotted to permit construction of something better than shacks without plumbing or lighting.

The Requirements Committee of WPB last week approved allotments of sufficient copper and steel to permit installation of more or less normal facilities in the remainder of the 300,000 houses approved last September. This didn't amount to a great deal, since most of these houses have been built or are building. The committee has not yet decided what to do about the 350,000 houses approved last March. However, its action on the first group is taken as indication that some provision will be made for the new batch.

These houses certainly won't be built, however, on the standards that would be expected in permanent houses of a sort attractive to private investment.

The same material shortages are affecting the program of municipal facilities being administered by the Federal Works Agency. Structures such as hospitals will have to be of the most temporary character—and very likely much smaller than seemed desirable a few months ago.

All FWA's War Public Works Projects are now being re-examined in the light of the current material shortages. Projects not absolutely essential will be dropped. And wood frame construction will be substituted wherever possible for masonry—even the simplified masonry.

Meanwhile, the Social Security Board pointed out last week that inadequate housing is already interfering with production by causing a high labor turnover and by leading workers to refuse jobs in over-crowded communities.

• • •

Contract for 21,946 war housing units in April

Contracts for 21,946 war housing units were awarded during the month of April, the Federal Public Housing Authority said in its first overall housing tabulation release last week. The total included 17,656 family units, dormitory space for 3,640 persons and 650 trailers.

One thousand and eleven war housing projects, containing 367,522 homes are either complete or under construction the FPHA said.

Sewage convention to stress wartime problems

Sewage works operators and engineers, already hard pressed by the problems of serving expanding war industries and population, will devote the major part of their third annual conference to discussions centering on war-born matters.

The convention is to be held at the Hotel Statler, in Cleveland, Ohio, Oct. 22-24.

Leading authorities on sewage work, student training, state health control, army camp sanitation and industrial waste problems will discuss their specialties at the meeting. Progress of sewage work construction during wartime, the question of priorities and conservation of materials will be featured, while plant operators present their experiences in a symposium on plant maintenance in war times.

Convention committee chairmen include: William L. Havens, management committee; F. Wellington Gilcreas, program; Morris M. Cohn, publicity and attendance; Angus MacLachlan, local host committee; Curry E. Ford, registration; J. W. Ellms, inspection trip.

. . .

M. R. Keefe dies, was Indiana road engineer

Merton R. Keefe, 60, chief engineer of the Indiana State Highway Commission, died recently at Evansville while attending a conference of road officials there. His home was at Lebanon, Ind.

A graduate of Purdue University in 1902, Mr. Keefe served as an engineer for the Baltimore & Ohio Railroad and for the Rock Island Railroad before joining a contracting firm whose work took him to Persia, Greece, Poland and other European countries and South America. Among projects he built or engineered was the water supply system in Athens, Greece; a drainage and reclamation project in eastern Macedonia and the water and sewage system at the U. S. Navy's Hog Island shipyards, Philadelphia, Pa.

He was a member of the Am. Soc. of C. E., Indiana Society of Professional Engineers and the National Society of Professional Engineers, and had served as president of the Indiana Engineering Council. Among other honors, Mr. Keefe had been president of the Mississippi Valley Conference of State Highway Departments and vice-president of the American Society of State Highway Officials.

He became chief engineer for the highway department in 1933, holding that post until he resigned in 1940 to enter private work. He returned to the highway department in August, 1941, to assume his former duties as chief engineer.

New chief engineer for Canadian Army Overseas

Maj. Gen. C. S. L. Hertzberg, formerly chief engineer of the Canadian Army Corps, has been named chief engineer of the recently created Canadian Army Overseas, on the staff of Lieut. Gen. A. G. L. Macnaughton.

General Hertzberg was promoted from brigadier to major general when his new duties were announced.

Born in Toronto, Ont., of Norwegian parents, General Hertzberg graduated from the School of Practical Science in 1905 and practiced structural engineering until 1914, when he served overseas with the Canadian Engineers, receiving decorations from the British and Czechoslovakian governments for distinguished service. On his return to Canada, he took up structural engineering with A. L. Harkness in the firm of Harkness and Hertzberg.

In 1939 he was appointed to command the Canadian first divisional engineers, being promoted to the rank of colonel in May 1940 and shortly afterward to the rank of brigadier.

Wait decision on charges against highway chief

Taking of evidence in an ouster proceedings against William J. Cox, Connecticut highway commissioner were completed last week before State Referee George E. Hinman at Bridgeport, and a final decision is expected early in June.

Governor Robert A. Hurley suspended Mr. Cox early in February after Attorney General Francis A. Pallotti had charged the highway chief with negligence and incompetency. Hearings before the referee were completed May 12, and briefs were presented May 18.

The referee's findings will be submitted to the governor within the next two weeks.

Santee-Cooper enjoined from property purchase

The South Carolina Supreme Court last week issued a permanent injunction forbidding the South Carolina Public Service Authority from purchasing the $40,000,000 properties of the Associated Gas and Electric Co. at Columbia.

The authority, which built and operates the Santee-Cooper hydro-electric project near Charleston, had entered into a contract with the utility, pending court approval (ENR April 16, p. 588).

In a 4 to 1 decision the court said that the authority is not empowered under the enabling act of 1934 to purchase or acquire the plants and facilities of the utility company.

"Nowhere in the charter do we find any language upon which to hinge the vast powers now contended for by the authority," the court said. "It would have been a simple matter for the legislature to have explicitly provided for the purchase of established, existing plants and public utilities in the area claimed. It has not done so."

. . .

Roadbuilding ruled not interstate commerce

A highway contractor engaged in the reconstruction of repair of a city street or a highway is not engaged in interstate commerce or in the production of goods for interstate commerce, the Louisiana court of appeals ruled in a decision last week.

The case before the court involved the tearing up of old pavement and the laying of new pavement much wider than the original, as well as installation of new drainage, sidewalks, gutter bottoms and curbs. Another project involved in the same case was that of constructing a new two lane paved roadway which, when completed, became part of the state highway system.

Noting that neither the city street nor the highway became part of the state highway system until some time after they were completed, the court conceded that the street in question had long been used by trucks and automobiles engaged in business relating to interstate commerce.

The court said: "We cannot say that such use would have the effect of making it indispensable to the conduct of such commerce with the result that a workman engaged in the repair and reconstruction of the street would be considered as employed in interstate commerce. To begin with, it is going very far to say that a city street, even when it has been officially designated as a component part of a state highway, is an instrument of interstate commerce."

Construction limitation order emerges as regulatory measure in application

Easing of application to most highway work last week and rate of approval of housing work seen as evidence of new trend.

Last month's construction limitation order, L-41, is proving to be considerably more flexible in its application than at first appeared probable.

First interpreted as a device to halt non-war construction, the order now appears to be developing more as a regulation of construction than as a means of halting such work.

As originally administered by Sullivan Jones, priorities chief of the Federal Housing Administration, FHA offices were instructed to reject at least 99 out of every 100 applications for permission to start construction. Within a few days, however, administration of L-41 was transferred to Esty Foster, who with Sullivan Jones is attached to the new WPB construction bureau headed by W. V. Kahler (*ENR* April 16, p. 583).

Less restriction on roads

Typical of the current approach, also, is last week's order, L-41-600, which essentially exempts most highway work from the terms of L-41. As predicted in these pages (*ENR* May 7, p. 53), any public agency may now initiate construction of road jobs without obtaining approval from WPB. Only requirement is that a report be made monthly on the estimated material requirements of projects started. These reports are to be made through the state highway departments and the Public Roads Administration on PRA's form PR-46.

One limitation on this blanket permission eliminates from its provisions projects that require the purchase of steel reinforcing bars, metal culverts, or structural shapes. It is permissible to use steel already in stock, but any project requiring purchase of further steel must be submitted for authorization in the usual way—routed through the state highway departments and by them to the PRA.

A similar trend is evident in the exemption for construction of sets by movie companies, noted last week. Foster's unit is now approving about 90 percent of the 300 or more applications submitted to it daily under the new arrangement.

Local FHA offices receive less discretion in administration of the order than at first appeared likely. As regards applications for authority to build houses, they have the power to reject, forwarding to Washington for final approval only those applications they favor. Applicants who are turned down are permitted to appeal to Washington. Applications for approval of non-residential construction also all go to Washington, local FHA offices acting only as collection agents. Applications for farm construction do not go through FHA at all, but are handled through the county defense committees of the Department of Agriculture.

Question continuance

The low rate of rejections in housing noted above probably will not last. So far, the bulk of the applications have concerned projects which were on the point of getting started on April 9 but could not, technically, meet the definition of "starting construction" in L-41, i.e., that material actually had been incorporated in the project. In such cases, authorization is generally granted. After cases of this kind have been dealt with, the percentage of rejections will probably rise.

How long this lenient interpretation can continue in the face of a constantly tougher attitude in WPB toward the use of materials is questionable. In any case, the ever tighter materials situation will make an authorization without a priority rating mean less and less. Significantly, the road exemption, L-41-600, emphasizes that projects started under this authorization must not expect to get priority ratings merely because they run into difficulties on materials.

• • •

Kansas floods damage highway bridges

Recent floods of the Cimarron and Arkansas rivers in Kansas caused damage estimated at $250,000 to highway bridges in the state, D. J. Fair, highway director, reports.

Fair said the principal damage occurred to bridge approach fills, and added that his department was uncertain as to when and what sort of replacement could be made. Eight state and federal roads were listed as blocked due to the damage.

Revamp road plans to meet stop order

State highway departments last week had started to bring order out of confusion in their plans caused by the issuance of WPB's stop order, and hoped for modification while adjusting themselves to the new state of affairs.

Four state road projects in Virginia had been approved by the government as essential war work, including bridges and approaches at the Nottoway River in Dinwiddie County and across Shiny Creek in Brunswick County; a two-lane concrete highway west of Waverly, and macadam surfacing at Old Glad. In Texas, improvement and construction work on 90 miles of strategic military highways in five counties, to cost about $1,880,000, also were approved.

Meanwhile, in Ohio, Hal G. Sours, director of the department of highways, instructed all district engineers to lay in supplies of substitute materials such as wood for essential repairs, and predicted that a part of his department's 1942 program could be carried out. Thomas H. Cutler, chief highway engineer for the Kentucky state highway department, reported that he had ordered 3,000,000 gallons of asphalt for state road repair, in an effort to stock up before restrictions on transportation made it impossible to obtain the material. The state has 2,053 miles of traffic-bound gravel roads which need "black topping" with bituminous or similar coating.

In New York the state legislature passed a bill to freeze most of the funds to be provided by a $60,000,000 bond issue authorized by voters at November elections for grade crossing elimination. The bond issue will be held in reserve to form a part of a large post-war public works program.

I. Lamont Hughes, secretary of highways for Pennsylvania, commented that restrictions will "knock our program galley-west," explaining that the state will be able to obtain only one-eighth of the required tar and oil for its $53,000,000 highway program.

North Carolina officials also looked apprehensively at the future, fearing that curtailment in the sale of asphalt will hurt its road system more than lack of tires and gasoline.

Two counties, one in Georgia and one in Florida, also suspended all road work, excepting that required by the government, for the duration of the war.

Despite the curtailment in road work, the Connecticut state highway department announced it will apportion $2,000,000 to officials of various towns for work on unimproved roads. The Ohio Department of Highways also announced the apportionment of nearly $10,000,000 for general road work. Michigan apportioned $4,000,000 for similar purposes.

Affected by the loss of men to other phases of the war, the Iowa highway commission increased its work week to 48 hours from 40 hours, to take up the slack of men leaving commission employment.

WASHINGTON HIGHLIGHTS

APPROPRIATION of an additional $200,000,000 for construction of semi-civil airports in this country and Alaska has been recommended by a Senate committee. This new money will double existing appropriations, which have provided for improvements or construction of 504 fields. The proposed appropriation would permit continuation of work at 266 of these fields as well as initiation of projects at another 164 existing or proposed fields.

SEVERAL proposals for projects to increase oil transportation to the east coast are getting active consideration in Washington. Most prominent is a scheme to connect the Gulf Intracoastal Waterway with the Atlantic Intracoastal Waterway by either a pipeline or barge canal across Florida or both. Such a project would permit movement of oil by barge from the Texas fields to New York. It is coupled with schemes for construction of a lot of wooden barges. The project has been discussed with the President by congressional leaders and would be authorized by a bill on which the House rivers and harbors committee is now holding hearings. This bill would provide for immediate construction of a $10,000,000 pipeline across Florida, taking about six months and construction of a barge canal along the general route of the old ship canal. It would also authorize deepening of the gulf waterway to twelve feet from it's present nine foot depth. Cost of the project would be about $144,000,000.

THE Florida project is opposed by Oil Coordinator Ickes, who is pushing ahead for his proposal of a new pipeline from Texas to New York. This scheme has twice been turned down by WPB and its predecessor, but Ickes presented it to WPB once more this week.

A USED construction machinery section has been established in WPB's construction machinery branch. It is headed by Hamilton O. Penn, president of the H. O. Penn Machine Co. of New York.

SALE of lumber to distributors was forbidden for sixty days by WPB last week, as expected (*ENR*, May 14, p. 2). The order applies to softwood "construction lumber" produced by mills whose production during the past three months has averaged more than 5,000 b.ft. per day. Such mills are forbidden to sell except to the Army, Navy, Maritime Commission, or their contractors. It is expected that the 7,000,000,000 b.ft. now held in retail yards will meet other needs for the period, but there is some fear that uneven distribution of stocks may cause shortages in some areas.

INSTALLATION of new air-conditioning or commercial refrigeration equipment is forbidden by WPB order L-38 except on orders bearing an A-9 or better rating.

ROADBUILDERS possessing a P-19-e preference rating are now permitted to apply the rating to purchase of materials for detours and other temporary construction necessitated by the road job. Previously they could only use it for material entering into the project itself.

THE machinery price order (OPA regulation 36) will not go into effect until June 1. Originally scheduled to become effective May 18, the order freezes the price of nearly all new and used machinery—including construction machinery—at the levels of last October. Price of any item of new equipment is the price charged by the same seller last October. Rebuilt used machinery may be priced at 85 percent and other used machinery at 55 percent at the October price of the most nearly comparable new machine.

• • •

Call bids on Ross Dam enlargement project

The Seattle Board of Public Works, last week, called bids for raising the height of Ross Dam, on the city's Skagit hydroelectric project, bids to be called on June 11.

The contract (ENR Feb. 26, page 313) involves placing 385,000 cu.yd. of concrete, more than a billion pounds of reinforcing steel, and 94,000 cu.yd. of rock excavation. A variable arch structure of reinforced concrete, Ross Dam was completed to its present height three years ago, but was so constructed as to permit enlargement as required by the roads of the city's demands for power.

The dam is at present 305 ft. above bed rock and creates a reservoir eight miles long, impounding about 100,000 acre-feet of water.

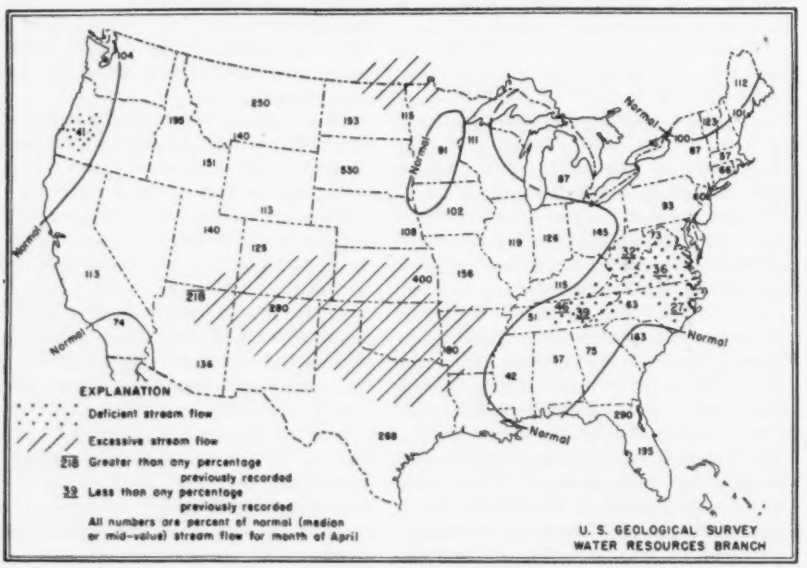
• • •

No toll on parkway

A proposed toll charge of 25 cents per day per car for use of the Blue Ridge Parkway in North Carolina has been postponed by the National Park Service.

The toll was to have gone into effect May 1 (*ENR* April 30, p. 753).

Drought in Mid-South, floods in West feature April stream picture


EXPLANATION
Deficient stream flow
Excessive stream flow
218 Greater than any percentage previously recorded
32 Less than any percentage previously recorded
All numbers are percent of normal (median or mid-value) stream flow for month of April
U. S. GEOLOGICAL SURVEY
WATER RESOURCES BRANCH
Normal

Drought in an area from the Virginia seaboard to central Tennessee, and unusual floods in a broad area covering six states, including Colorado, New Mexico and the southern Plains States, were outstanding stream-flow features during April. In some respects, these conditions are a repetition of those of last year, except that both the flood areas and drought areas are more localized and intense.

Otherwise, stream-flow conditions are not unfavorable. Flow has increased in the Pacific Northwest, and reservoirs in New England are filling. These are favorable events of the past month, but long continued above-normal rains are needed in the eastern drought area to avert a repetition of last year's adverse conditions in that industrial and agricultural area. The drought area, extending from the upper Tennessee Valley to the Virginia seaboard, averaged only 36 percent of normal flow.

OBITUARY

Charles A. Sims, civil engineer and president of the Sims Construction Co., of Philadelphia, Pa., died May 13. For many years assistant engineer in charge of construction surveys for the Pennsylvania Railroad, Mr. Sims built the only bridge that withstood the Johnstown flood in 1889—the stone bridge over the Conemaugh River. He also built the four-track Pennsylvania Railroad span over the Delaware river at Trenton. A native of Memphis, Tenn., he resided at Warwick, Pa.

William Emerson Worley, 67, consulting engineer at the Milwaukee Ordnance Plant since May 1, died May 14. Mr. Worley was chief inspector for architectural and engineering work on the project, employed jointly by the firm of Smith, Hinchman & Grylls, of Detroit, and J. Donohue Engineering Co., of Sheboygan, Wis.

John C. Hopkins, 77 an engineer and surveyor, died May 15 at Dover, Del.

George Leary, 73, president of the Morris & Cumings Dredging Co., Inc., of New York, died recently. A specialist in drydocks, Mr. Leary aided in construction of the naval drydock at Norfolk, Va., and was contractor for much of pier and dock work in south Brooklyn.

George Edward Gregory, 72, civil engineer for 40 years connected with the New York Public Works Department, died at White Plains, N. Y., May 17.

Morris S. Perrault, 61, for 25 years a civil engineer for the Kansas City Southern Railroad, died recently at Kansas City.

Freeman C. Fitzgerald, 50, an engineering graduate of Notre Dame University and Milwaukee, Wis., manager of the Ceco Steel Co., died recently at Milwaukee.

Charles Forster, 65, operator of the Springfield, Ill. sanitary district plant for 12 years, died May 15.

Fred R. Smith, 42, former chief project engineer for the WPA in Alabama and a prominent bridge contractor, died recently at Tuscaloosa.

George D. Evans, 68, former commissioner of public works of Peekskill, N. Y., died May 15. He had been employed as engineer for the New York Central Railroad for 20 years before coming to Peekskill.

Fletcher Gorham Tufts, 40, of Briarcliff Manor, N. Y., former engineer for the Westchester County Sewer Commission, died May 14 at Eastview, N. Y.

Frederick W. Fratt, 82, Kansas City, Mo., railroad construction engineer, died May 15. A graduate of the University of Wisconsin, Mr. Fratt entered railroad work in 1878, and became chief engineer for the Wisconsin Central railroad in 1888. In 1892, he became chief engineer in charge of construction for the Missouri-Kansas-Texas lines in Texas, and came to Kansas City in 1904 to supervise construction of M-K-T terminals there. He was builder of the famed Armour-Swift-Burlington Bridge, designed by the late J. A. L. Waddell.

James P. Graham, 83, who retired 10 years ago after 30 years of general contracting in Brooklyn, N. Y., died May 19 in New York City. In his later years Mr. Graham was a building consultant. One of his last big jobs was construction of a 25-mile sewer project on Long Island. He was at one time president of the Philadelphia section of the American Association of Engineers.

CONTRACTS AND CAPITAL

ENGINEERED CONSTRUCTION volume for the week totals $216,513,000 the eighth time in 21 weeks since the beginning of the year that the total has topped the $200,000,000-mark. The week's volume is 315 percent higher than in the corresponding 1941 week, but is 6 percent under a week ago.

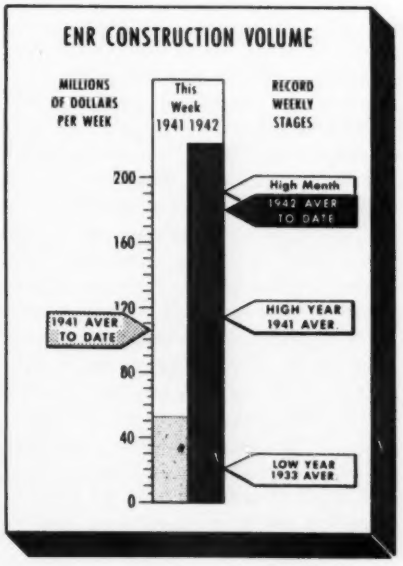
The high totals of the opening three weeks of May bring construction to $881,345,000 for the period and insure a new record volume for the month.

Public construction for the current week is 479 percent above last year, however, it is 3 percent under the high total of last week. Private construction is 44 percent and 46 percent lower, respectively, than a year ago and a week ago. Federal work is responsible for the week's high volume, and is 1,367 percent above the 1941 week, but 3 percent under the preceding week.

The current week's total boosts 1942 construction to $3,773,129,000, a 73 percent increase over the volume for the 21-week period in 1941. Private construction, $295,303,000, is 51 percent below the period last year, but public work, $3,477,826,000 is 120 percent higher than a year ago as a result of the 205 percent gain in federal construction.

In the classified construction groups, gains over the 1941 week are in waterworks, sewerage, public buildings and unclassified construction. Increases over the preceding week are in sewerage, public buildings, earthwork and drainage, and streets and roads.

New capital for construction purposes for the week totals $26,448,000, an increase of 328 percent over the volume for the corresponding week last year. New construction financing for the year to date, $6,811,776,000, is 110 percent higher than the total reported for the 21-week period a year ago.



CONTRACTS

(Thousands of dollars)

	Week Ending May 22 1941	May 14 1942	May 21 1942
Federal	$13,331	$202,126	$195,721
State & Municipal	22,452	10,380	11,487
Total public	$35,783	$212,506	$207,208
Total private	16,563	17,371	9,305
TOTALS	$52,346	$229,877	$216,513

Cumulative
1942 (21 weeks) $3,773,129
1941 (21 weeks) $2,181,814

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1941 21 weeks	1942 21 weeks
NON-FEDERAL	$368,188	$272,821
Corp. Securities	109,342	87,366
State & Mun.	209,067	138,042
U.S.H.A. loans	22,550	.....
R.F.C. loans	27,229	47,413
FEDERAL	$2,868,837	$6,538,955
TOTAL CAPITAL	$3,237,025	$6,811,776

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	May '42	272.30	130.89
Building Cost	May '42	220.14	119.00
Volume	Apr. '42	569	249

FHA MORTGAGES

	Week Ending May 17 1941	May 9 1942	May 16 1942
Selected for appraisal			
Title II	$35,266	$21,210	$15,837*
Title VI	$ 6,503	$12,769	$11,162*

* Subject to revision.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Mixing Time for Concrete

Sir: The effect of time of mixing concrete has been variously reported during the years, as in *Proceedings* American Concrete Institute, 1918, p. 22, 1929, p. 344, *California Highways*, Feb. 1926, *Public Roads*, July 1928, and elsewhere. Particularly valuable is the article by Major F. S. Besson, in *ENR*, Feb. 9, 1933, p. 183. These writings have chiefly been concerned with effect upon strength, but likewise consider workability.

It is difficult to see what benefit is to accrue from mixing prolonged beyond the time necessary to accomplish thorough dispersal and intermingling of the component ingredients. The modest gains in strength with longer mixing sometime observed have been attributed to greater evaporation of mixing water during the lengthened mixing period but the same result can be obtained by not putting in so much mixing water in the first place. The other improvement attributed to lengthened mixing—increased workability—may be equally secured by more careful grading of aggregates, by more careful batching, by admixtures and other means.

Recently the effect of increased time of mixing was evaluated on a large paving job in the west. It was specified that each batch of concrete be mixed 90 seconds but contractors were invited to submit proposals based on 60-second mixing. The result was that the two lowest bidders each offered to reduce his price 10¢ per sq.yd. with the 60-second mixing. Since nearly 600,000 sq.yd. of pavement were involved, a saving of $60,000 was made possible by this change. The alternate did not say so in these precise terms but nonetheless did propose that the contractor increase the productivity of his mixing plant by nearly 50 percent. Evidently the contractors liked the idea.

If an owner were to daily visit his job and throw handfuls of silver dollars into its fresh plastic concrete for the purpose of improving and benefitting it, there would be general disapproval of the act. It would be felt that the gains were incommensurate with the costs. The economics of the procedure would be questioned. It probably would be said that Mister Man would be smarter if he kept his money in his pocket and bought something with it.

The $60,000 saving referred to suggests a re-examination of time of mixing to determine what, with modern equipment and generally improved modern control, is a reasonable period to specify. That much mixing time is necessary; more than that is a costly, useless extravagance.

HOMER M. HADLEY
Regional Structural Engineer
Portland Cement Assoc.
Seattle, Washington

Restrained Cable Bridges

Sir: I note Mr. Turner's method for dampening out cumulative oscillations in a suspension bridge, *ENR* April 9, p. 533. While this scheme may serve its purpose admirably it seems to me that Mr. Turner is somewhat off in his assumptions regarding the stresses caused in the main cables by the use of his stay system.

In paragraph 3 he says "In distorting the natural [parabolic] curve of the cable [as shown by dotted line in his sketch] and sharpening the curvature next to the towers [as shown by solid line] the secant of the angle of inclination of the cable, which determines the stress therein from the load reactions, is reduced; hence, the cable when distorted can support a greater load without increase of section [or maximum stress]. The vertical components of the ties constitute these virtual additional loadings and while they do not increase the maximum stress in the cable, they do increase what would be the minimum stress at the center of the span." It is hard to see how the secant of the angle of inclination at the towers is reduced if the curve of the cable is sharpened near the towers and the angle of inclination necessarily increased, since the secant increases with any increase in the angle of inclination. If my understanding of the mechanics of tensile stress in suspended cables is correct, T at any point along the cable is equal to the horizontal component times the secant of the angle of inclination at that point. Consequently at midspan where the angle of inclination is zero T is equal to the horizontal component. Now if the stress at midspan is increased by the use of his tie system, then the horizontal component over the entire span is increased and if the angle of inclination at the towers is also increased by sharpening the curve of the cable there, then it would seem that the stress in the cable is increased at the points of maximum stress as well as at the center of the span.

The insertions in parentheses are mine.

I am not criticizing Mr. Turner's scheme for taking the jitters out of a suspension bridge. In fact it looks like he really has something there that may prove both effective and economical. I merely question his basic assumption that the stress in the main cables at the towers will be reduced—rather I think it will be increased though perhaps not to any serious extent. At any rate his design could hardly develop stresses so out of hand as those which developed at the Narrows Bridge at Tacoma.

A. TIGGELBECK
Civil Engineer
Sandpoint, Idaho

Sir: Mr. Tiggelbeck's engineering intuition has resulted in a favorable reaction to the writer's restrained cable suspension.

He appears to have taken a surveyor's conception of inclination between the horizontal and the member rather than the bridge builder's treatment of inclination in computation as the angle between a member resisting shear and the direction of the load giving rise to the shear. The angle that the cable makes with the vertical direction of the load is to be considered in multiplying the shear by the secant of this latter inclination.

If the stress were to be determined in terms of the angle of the inclination to the horizontal, then the cosecant of that inclination would enter the computation involving W. By moments, if D is the sag of the cable at midspan, L the span length from tower to tower and W the total uniform loading, then the horizontal stress in the cable at midspan is:

$$(W/2 \times L/4) \div D = H$$

H is the horizontal tension at midspan with unstrained ties.

Under uniform load, the contour of the cable is parabolic and a tangent to the cable at the tower would intersect a vertical through midspan at $2D$ below the level of the tower support. As H decreases as D increases, the cable tension at the tower under the same load W decreases with the decrease in the secant of its inclination to the vertical.

Mr. Tiggelbeck's understanding of the relation of the cable stress at the tower to the stress at midspan is correct. Given that horizontal component, the cable tension at the tower is H times the secant of the horizontal angle of inclination, but to determine H directly from the load, its value is $W/2$ times the co-tangent of the inclination of the cable to the horizontal; and in turn the cable stress is H times the secant of the inclination to the horizontal so that the only difficulty with Mr. Tiggelbeck's position lies in his failure to coordinate the vertical load with the sag of the cable in his treatment of inclination.

The horizontal tension on the cable under partial load is greater on the unloaded side of the cable clamp and less on the loaded side. In other words, the horizontal component of the tie stresses opposed by the box strut balance each other under uniform load on the two sides at the center of span and the shear between the box strut and the cable through the cable clamp is zero; but with the load on one side, the reduced stress on the diagonal ties leaves an unbalanced condition such that the thrust of the ties on the unloaded side is thrown into the cable on that side and causes by this action the counterbalancing arrangement which I have described in the earlier article.

This shear tends to straighten the cable in the unloaded half and increases the stress on the ties of that half so that both their vertical and horizontal components are increased. In this lies the novelty of the operation and its almost perfect restraint of the cable to its original contour.

C. A. P. TURNER
Consulting Engineer
Columbus, Ohio

Australia Memo on Ship Salvage

Sir: In your February 19 issue (p. 309), received in Australia on April 15, you show a photograph of the overturned liner *Lafayette* (formerly the *Normandie*) lying in a Hudson River slip.

It has occurred to me that a method of righting her worth consideration and investigation would be to weld onto her exposed bilge and possibly part of her bottom, a series of watertight tanks which, after the water inside the vessel had been evacuated, would be filled to a predetermined calculated level sufficient to bring her upright.

As a civil engineer with considerable experience in shipping matters I fully appreciate the enormous difficulties, and suggest that experiments with a suitable model would quickly show what merit, if any, the proposals contained.

J. M. THOMPSON
Phosphate House
515 Collins Street
Melbourne, Australia

Flight Strip Runways

Sir: My statement concerning surface loads for flight strips, as reproduced on p. 541 of your April 19 issue, that "new heavy bombardment designs up to and including the spring of 1944 will call for . . . static wheel loads of 60,000 lb., tire inflation of 70 lb. . . . with a design stress requirement of 583 lb. per sq.in. . . ." was clearly erroneous. I regret that this mistake, which was committed in the preparation of my paper, was unnoticed by me.

When the ratio of horizontal to vertical speed of landing aircraft is considered—approximately 120-150 ft. per second horizontal to 1–5 ft. per second vertical—it becomes apparent upon plotting the horizontal and vertical vectors and determining their resultant that applied loads normal to runway surfaces are such as to give to an impact factor allowance of 25 percent a very considerable margin of safety. Using the data submitted in my article, a 60,000-lb. load with 70-lb. tire inflation pressure would produce a gross contact area of 857 sq.in. Using a correction factor of 0.9 to compensate for tire rigidity, the net contact area would be approximately 771 sq.in. Sixty thousand pounds divided by 771 sq.in. equals 78 lb. per sq.in. uniformly distributed unit load. Employing the arbitrary factor for impact of plus 25 percent increases this unit value to 97.5 lb. per sq.in. For convenience 100 lb. per sq.in. may be used.

There will undoubtedly be difference of opinion as to the need for runways designed for stress requirements of 100 lb. per sq.in. It is well recognized, however, that design based solely upon calculations of applied load would not produce a flight-strip runway predictably able to stand up under all conditions. To make provision for the various factors which must be considered, including the various weather conditions which will be encountered in the different areas where flight strips will be constructed, individual site study is clearly necessary, and soil, soil moisture, climate, temperature and drainage must be evaluated. It is clear also that recognition must concurrently be given to the part which maintenance must play in preserving the strength of flight-strips runways during their years of service. Both rigid and flexible types of flight strips are designed upon the basis of existing subgrade conditions, and no information yet available indicates the need for any radical changes from conventional highway design, so long as the work is done by engineers who know the characteristics of the region with respect to soil, climate and materials.

STEDMAN SHUMWAY HANKS
Lieutenant Colonel, U. S. Air Corps
Washington, D. C.

Transforming Vertical Curves

Sir: Errors made in setting some of the formulas in type in a letter of mine published in your issue of Jan. 15, 1942, p. 81, make the text of the second and third paragraphs incomprehensible. The second paragraph should read:

Any vertical curve that connects tangents of opposite slope must have either a high or a low point, depending upon whether it is a hump or a sag curve. If we call this point the point of horizontal tangent (P.H.T.) we may locate it directly from the grades given. The relationship is $\left(\frac{G_1}{G_1 - G_2}\right)L$. This is the horizontal distance from the P.C. The vertical distance from the P.C. is

$$\left(\frac{G_1^2}{G_1 - G_2}\right)\frac{L}{2}$$

The last sentence of the third paragraph should read: This in terms of grades is $\frac{G_1 - G_2}{2L}$, or $\frac{10}{12}$.

CHARLES MACKLIN
Structural Draftsman
St. Louis Ordnance Plant
Normandy, Mo.

EDITORIALS

VOLUME 128 NUMBER 21

May 21, 1942

Construction Equipment's Part

SOME MEASURE OF PROGRESS made in developing road construction equipment since World War I is found in a review of the article on old methods of roadbuilding by Charles T. Fisher in this issue. The modern equipment now being used to build our vast airfields was only beginning to take crude form 25 years ago. Were we still limited to the slow hand methods or the not much faster machine operations of that day, the fast production of high-class runways that is common practice now would be impossible of attainment. And much the same thing is true of the whole construction program that is such an essential part of our war effort. The vast expansion of the nation's capacity to produce basic materials, war machines and munitions could not be made at anything like the present rate were it not for great improvements in construction equipment, motor vehicles and power tools that have come since the first World War.

Pre-Assembly Now Standard

UNDER THE PRESSURE of wartime, prefabrication and pre-assembly of component parts has come into such widespread use in the construction industry that they can be said to have become standard practices. The up-to-date job manager must now consider whether, how and to what extent pre-assembly would speed and facilitate his work. Wherever a "bottleneck" results from limited working space, there may be some way to perform part of the work in advance, delivering pre-assembled units that lessen labor requirements at the critical point. In airplane plants, in shipyards and in mass housing projects, this plan has greatly speeded production. A major advantage, of course, is in subdividing a complex operation into a number of simpler and separate operations, thus making it possible for more workers to get at it. In a large shipyard, for example, welders in nearby sheds assemble large sections of the steel hull, which are then moved out by cranes to the ways, where they are quickly welded together, freeing the launching ways (which constitute a "bottleneck") much sooner than by the old method. So widely has this general idea been applied that return to the old system of bringing up unprepared materials, piece by piece, now seems improbable.

From Highways to Airports

HIGHWAY MAINTENANCE FORCES in areas not subject to possible emergency demand are a potential source for airport construction and maintenance crews. Operating on inadequate budgets for years, these men have learned to get the most from a little and they are skilled in making machines last far beyond their usual span of life. Not only are they familiar with drainage and snow disposal problems, but they have developed special abilities in patching and maintaining paved surfaces. Limitations on use of materials for highway maintenance soon may make it necessary for many of these skilled workers to seek other jobs. This potential pool of men and equipment profitably could be employed to promote the war effort. Possibly all airport maintenance could be turned over to such crews who, over the years, have developed a "best" method of working under local conditions. Such a procedure might be especially helpful in connection with new airports where difficulty exists in assembling experienced crews and necessary equipment. Highway maintenance men who long have been a factor in aiding the mail carrier "to complete his appointed rounds" are in a position where they can contribute their bit to "keep 'em flying."

City Traffic in Wartime

MR. EASTMAN'S Office of Defense Transportation started none too soon to press cities to seek solutions for their traffic problems. Not only are workers in cities spending a quarter to a third as much time getting to and from work as they do at work, but they are wearing out tires so fast that their means of getting to work at all will be gone within a year. That is the situation as described by the California State Railroad Commission in a report on the traffic problem confronting San Francisco and the nearby East Bay cities. A similar story could be reported for Los Angeles, San Diego, Portland and Seattle; and the situation is as bad or worse in Hartford, Norfolk and Pittsburgh. It is serious enough everywhere because cities always have tended to procrastinate on their traffic problems. Other problems—concerned with water supply, sewerage or a new city hall—are attacked directly, but the appearance of a traffic problem has always been the signal for cagey maneuvering

and obstructive, delaying tactics. No one knows this better than engineers who have been called in to work out a traffic-handling scheme for a city, only to succeed in presenting a report that was promptly marked "file and forget." Perhaps the absolute necessity of keeping war workers working will bring about a changed attitude in this respect. Actually, many of our present traffic problems would dissolve in the face of an unrelenting will to solve them. If workers were made to ride four or five in a car, congestion would be cut in half and vital tires would be saved. If parking lots served by buses or street cars were provided a mile or more from the plants, the traffic nightmare at shift changes would be eliminated. As a further aid, abandoned ferry lines and street railways could be returned to service. And if a narrow bridge is a bottleneck, a temporary trestle can be built alongside, permitting one-way traffic both ways. In brief, an engineering approach to the traffic problem is all that is needed. But politics and the delaying tactics of special interests must first be swept away. Mr. Eastman and his ODT perhaps can wield the necessary broom.

Engineers in Training

ONE OF THE PROBLEMS facing many of the young engineers now graduating from engineering schools in this country is that of keeping fresh their knowledge of engineering theory during the years required to obtain the practical engineering experience that they must have before applying for examination for an engineering license. An increasing number of states now require written examinations in engineering theory, and New York State, which has led in the movement to stiffen the license requirements, submits applicants to an unusually comprehensive examination after they have acquired the specified practical experience.

It is gratifying, therefore, to find New York taking the lead in meeting this problem of the young engineers by arranging to advance the examinations in theory to any time after graduation from college (*ENR* May 14, p. 817). The date when the first examinations will be held has not been set definitely, but the new plan, as reported at the annual meeting of the New York State Society of Professional Engineers last week, is expected to be in effect by the spring of 1943. New York's law does not require the written examination, hence the change can be made simply by changing the by-laws of the licensing board. (For the benefit of the many young men now going into the military service, inauguration of the plan this spring would have been highly desirable, but possibly the board will waive the examination for engineering graduates on completion of their service to the country.)

A problem not yet solved is that of giving the young men who have successfully passed their examinations in engineering theory some legal status while gaining the practical experience necessary to licensing as professional engineers. It is expected that the New York license board will designate them informally as "engineers in training," but as much is to be gained in building up professional consciousness in the younger men by giving formal recognition to that title or some similar designation, it is to be hoped that steps soon will be taken to amend the license law to cover this new group of engineers. And steps should be taken, of course, to revise the model license law so that there will be uniformity of action in other states as this movement spreads. Legislation to put a similar change into effect in New Jersey is now being drafted for consideration this year.

Viewed from the angle of developing a strong engineering profession, still another step is necessary. State societies of professional engineers should set up the grade of junior member to include not only these engineers in training but also the young men who are acquiring their engineering training the hard way—over drafting boards in the back office and at night school. The Ohio Society of Professional Engineers recently took the lead in this by establishing the grade of junior member, and a few weeks ago New Jersey took the first steps in that direction. The matter was discussed in committee and group meetings at the annual meeting of the New York state society last week but no formal action was taken. Membership now is limited to licensed engineers.

Young men long have sought the help in meeting their professional problems that can be made most effective by giving them a voice in the professional societies. Granting them some form of membership has been too long delayed. That they will contribute ably and enthusiastically to the work of those societies is assured.

ENGINEERING NEWS-RECORD WALDO G. BOWMAN, *Editor* *Copyright 1942, by McGraw-Hill Publishing Company, Inc.*

EDWARD J. CLEARY, *Managing Editor. New York:* V. T. BOUGHTON, J. I. BALLARD, A. N. CARTER, H. W. HUNT, E. R. DENMARK, E. E. HALMOS, Jr. *Chicago:* H. W. RICHARDSON. *Washington:* PAUL WOOTON, R. B. COLBORN. *San Francisco:* N. A. BOWERS. *Consulting Editors,* F. E. SCHMITT, W. W. DeBERARD

EDITORIAL OFFICES: 330 WEST FORTY-SECOND STREET, NEW YORK, N. Y.

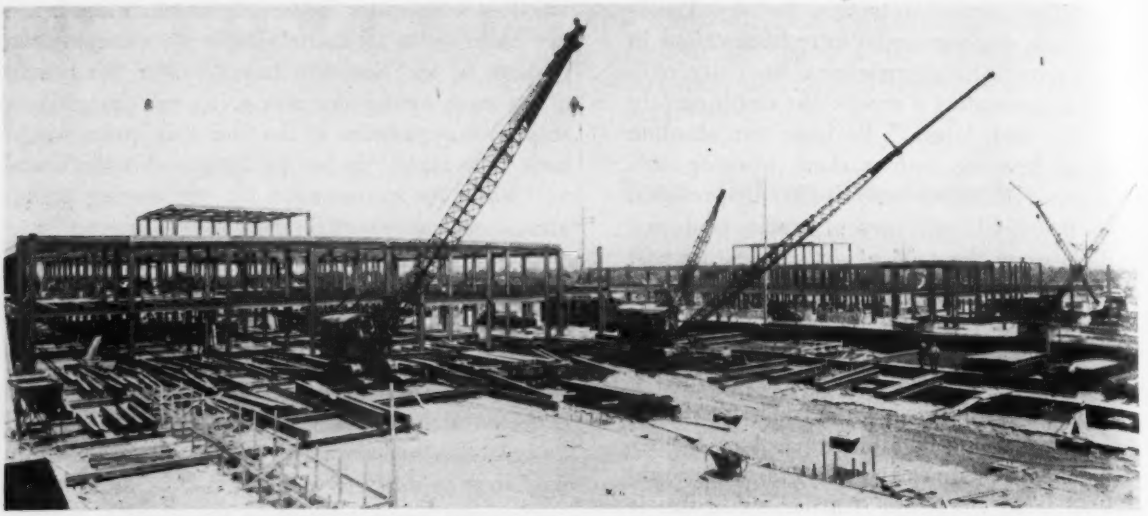


Fig. 1. Lack of storage space made it necessary to route steel direct from cars to erection cranes.

Big Arms Plant Built in Congested Area

***Contents in Brief**—A large plant for small-arms ammunition was required to be built in a relatively small tract in a mid-western city. Despite the congested site that precluded storage of materials and complicated access to various parts of the work, construction progress has been remarkable. The contractor's organization, built around premise of using materials as fast as they could be procured, included engineer coordinators assigned to all superintendents and a close control of subcontractors.*

MOST SMALL ARMS ammunition plants being built for the U. S. Ordnance Department are in wide open country, spread over an area of 15,000 to 25,000 acres, but one of the largest of them all is jammed into a comparatively small plot almost entirely within the corporate limits of a mid-western city. Yet despite the concentration of more than 300 buildings, some of them 200 x 1,045 ft. in size, into this relatively small area of rolling topography, with a difference in elevation of 70 ft., and involving widely variable soil conditions; despite lack of material storage space and handicapped by transportation difficulties around the crowded site, the contractor made remarkable progress in building the plant. The ability to spend over $60,000,000 in construction in nine months commands attention even in these days of gigantic construction achievement for the war effort.

The plant, with a capacity for ammunition manufacture about double that of other similar plants, is located at the fringe of the city. A main boulevard, formerly 60 ft. wide with two lanes of concrete slab, is being partly relocated and is being reconstructed into an 8-lane divided superhighway, but will still traverse the project.

A service highway overpass and a pedestrian bridge will connect the two parts of the plant separated by the highway. A belt railroad taps one corner of the site, at its lowest point, and grading of the tract and elevation of the buildings were dictated by limiting the layout of the spur railroad tracks to a maximum grade of 1½ percent.

Site characteristics

The site lies between an industrial area and a small home residential section and 25 houses had to be removed. All streets through the plot, except one, have been closed. Powder storage and a firing range, which requires a lot of space, are located in a 3,000-acre tract some distance from the plant. Gas, power, city water and sewer systems are available at the plant site. Some additional treatment, however, is required to bring the city water down to zero hardness for manufacturing purposes.

When the first construction contract was signed it was thought to be for the complete plant, but that part is now known as Plant I, and a month after work on it began word was received to enlarge the project by building Plant No. II. This was to be identical with Plant I, except for administration building, and tool and gage shop, but to have 150 per cent more capacity and an additional width of 40 ft. in the production buildings. A later order again increased production capacity through a greater concentration of operating machinery and a slight rearrangement of the buildings.

Practically all of the 300 buildings have brick walls, with either concrete or steel frames and concrete floors. Most foundations are simple spread footings, but concrete piles were required in a few cases where the ground was soft. Concrete was substituted for steel for the frame, bunkers and hoppers of the first boiler plant when lack of steel threatened a delay

Fig. 2. Because construction of the buildings could not wait on general grading of the site, slot excavations were made to facilitate the forming and pouring of concrete footings, thus speeding the erection of the structures.

in construction. Fabricating, erecting and holding in place reinforcing steel for columns 90 ft. high at the boiler plant was one of the job's biggest headaches.

A sudden decision to add a rather large building to the project left no time for normal procurement of steel from fabricating plants. Therefore, much of the steel framework for this structure was picked out, a beam, a column or a girder at a time, from warehouse stocks throughout the country. These pieces were supplemented by second-hand steel from the New York World's Fair.

In other similar plants the primer buildings are light frame structures, well isolated, each encircled by a high earth dike barrier. At this plant there is not enough room for the earth dike slopes, so the barriers are reinforced concrete walls, and the buildings are brick with light roofs that will easily give way in case of explosion.

The magnitude of the construction operations is indicated by some of the principal quantities: Site excavation, 1,668,000 cu. yd.; foundation and building excavation, 1,213,000 cu. yd.; concrete, 403,000 cu. yd.; forms, 10,000,000 sq. ft.; reinforcing, 21,000 tons; structural steel, 27,500 tons, and brick 25,000 M.

Besides the buildings, of course, there are railroads, roads, sewers, steam tunnels, fencing, water, gas, telephone and power lines. Also a complete street lighting system is being installed.

Construction operations

Construction started with a fleet of shovels, trucks and scrapers attacking the site and building excavations. Elevations of the buildings, especially in Plant I, were determined by the railroad grades, which required grading down and removal of over a million yards of dirt. Yet building construction could not wait on the site grading, so at first long slots were cut into the site at building locations. Then, from the high banks forming the slots, footing concrete was chuted to place from transit mixers. As soon as foundations were ready, steel erection and wall and floor construction began. Thus, the early schedule called for construction of the buildings and then removing the dirt from around them.

Scrapers were used on the short hauls, for cut and fill work, but most of the excavated material had to be removed from the site, requiring truck haul. Disposal was made in many unsanitary spots in the neighborhood, such as old quarries, sinkholes and swamps.

In the meantime, the contractor was continually in need of finished plans to work from, and the architect-engineer, handicapped by necessary planning with the ordnance depart-

Fig. 3. Excavation completed for a large building. Surrounding ground was cut down after construction was underway.

ment, the operator, and the consulting engineer on operating equipment, had great difficulty in providing them promptly. Only close cooperation among all concerned averted chaos on the job.

The contractor was also handicapped by lack of material storage space. Materials virtually had to be routed from box cars and trucks to the point of immediate construction use.

Movement around the site was a big problem in the early construction stages. Because of the cutting of slots for buildings and constant removal of banks between them, no system of roads could be built. Consequently, the crudest of temporary roads, usually just a few loads of rock dumped on the mud, had to suffice. For building Plant II it was possible to lay out and grade at least some of the roads in advance. The bases of permanent streets were used for temporary roads.

Then came the job of digging utility trenches. Certain parts of the plant were being rushed to completion for operation at the earliest possible moment. These parts, before going into service, must have steam tunnels and water, sewer, gas, power, light and telephone service. The contractor had to work his utility lines in and around site grading, foundation excavation, road and railroad construction, keeping access routes open around the site all the while for delivery of materials.

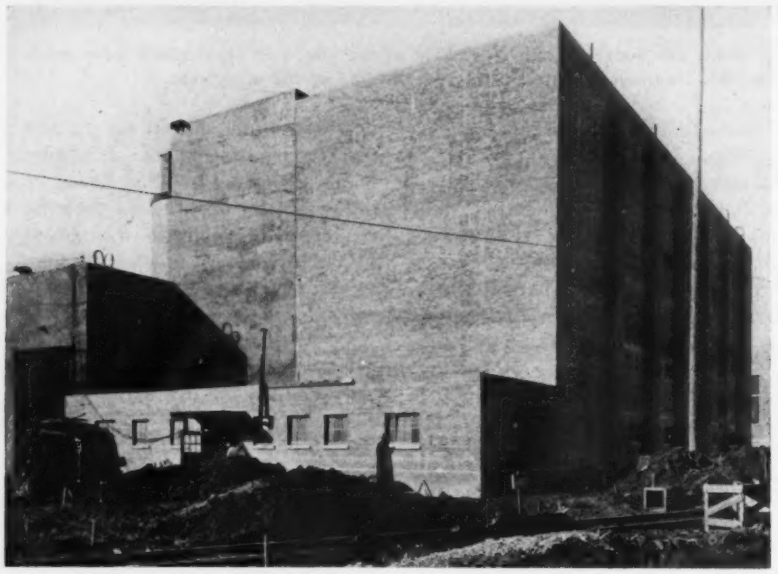


Fig. 4. Concrete was hurriedly substituted for steel in the frame and bunkers of this boiler house when a delay in steel threatened to hold up the job. Placing forms and reinforcing for the 90-ft. columns was a difficult task.

Fig. 5. There was no room for conventional earth dikes, so hazardous buildings are surrounded by concrete barriers, erected ahead of buildings they enclose.

For the first four months of the job work was carried on in three 8-hr. shifts, seven days a week, under a system of pole and portable floodlights. For the remainder of contract time, however, two 10-hr. shifts were worked, also seven days a week. At the peak of operations nearly 15,000 construction workers were on the payroll, most of them skilled tradesmen. At times a few trades were short of men, but in no case was construction seriously delayed or hampered by lack of labor.

While the main plant was under way the contractor also had to build the storage area 25 miles from the main plant, comprising scores of concrete igloos, small warehouses and railroad spurs and roads.

Contractor's organization

The contract was let on a negotiated fixed-fee basis. The contractors handled the job through an operating committee, although actual supervision was vested in a constructing manager. The operating committee directed the constructing manager, not the job.

Directly under the constructing manager was an assistant, a constructing engineer, an office manager, a subcontract director, a procurement director, a labor relations and employment manager, and a field engineer. Also reporting direct to the constructing manager were five general superintendents, three in charge of building areas, one on grading, roads, utilities and equipment, and one at the storage area. Each of the building area superintendents on the job had an assistant in charge of each shift.

One of the key setups in the whole organization, however, was a group of engineers assigned as coordinators between the office and field forces. These men, headed by a chief coordinator, and under the direction of the constructing engineer, worked with the superintendents in the field. They helped plan the construction operations, for they knew what part of the work was needed first, what materials had been ordered, were on their way or due next. The coordinators relieved the constructing manager of a great load of detail in his relations with the superintendents.

Fig. 6. Time was saved on this structure by building the brick parapet while waiting for completion of concrete base work.

Another factor that helped keep the job going smoothly was the contractor's relations with his sub-contractors. Four main fixed-fee subcontractors in fact were considered to be an integral part of the organization. Their men were on the general contractors payrolls, their supervisors were regarded as superintendents, and the general contractor paid directly for all their materials. There were also, of course, many small lump-sum subcontractors on the job, the general contractor operating on the theory that it was best to bring in as many as possible to handle special work to which they were best fitted by experience. Ready-mixed concrete was supplied by a subcontractor from a plant near the project, delivered in transit mixers.

In brief, the contractor's organization and planning were built around the idea of using materials as fast as they could be procured by personnel that had experience and that was given definite duties and responsibilities. Thus, the maximum flow of materials into the job was considered, a construction schedule was outlined to take care of this flow, and then equipment, labor and supervisory forces were obtained to meet the construction schedule. This plan worked well, and resulted in top construction speed. Of course, changes in procedure had to be made constantly to meet changing and unforeseen conditions, but the contractor's organization proved flexible enough to operate smoothly despite sudden shifts in the schedule.

Design and construction of this war plant was under the direction of the U. S. Engineer Corps.

Operating Experience On Pioneer Windowless Plant

THE FIRST windowless factory in the United States, accurately described by its designers and builders, The Austin Co. of Cleveland, Ohio, as a "controlled-conditions plant" is owned and occupied by the Simonds Saw & Steel Co. of Fitchburg, Mass. Although built in 1931, it stood idle during the depression, and not until 1939 was it placed in service. Since that date, however, careful records have been kept of operating experience, and some of the results have recently been released by the plant superintendent. Those pertaining to lighting and air conditioning are particularly significant.

A careful record, for example, was kept of the life of fluorescent tubes. The record shows during the first nine months of operation, from July, 1939, through March, 1940, that tubes averaged 3,800 hr. A subsequent period of 18 months, from April 1, 1940, through September 30, 1941, showed an average of 4,800 hr. per tube. No information is available as to whether tubes have a longer useful life if they burn continuously. At present, however, the Simonds plant is operating around the clock on three shifts, six days a week, which means that the lights are turned out only once and turned on once in a period of seven days. There has been no noticeable drop in the efficiency of tubes as they grew older. All of the fluorescent units are thoroughly washed twice a year, and this helps to maintain the lighting efficiency.

The cinder block side walls, which were left unpainted when the plant was originally completed, were painted about a year and a half ago, and are today practically free of dust and dirt as a result of the efficient control of atmosphere throughout the plant, which is crowded with heat treating and grinding machinery. A special white paint, developed for this service, has in no way destroyed the acoustic properties of the cinder block.

The ceiling, which was painted yellow just before the plant went into operation, is also entirely free of dust and discoloration in most places throughout the plant, although a fine powdery film has formed at certain locations above heat-treating furnaces, forges and certain rough and wet grinding operations. Vacuum cleaning restores the original ceiling condition without any use of paint.

U. S. Army Signal Corps

Manpower first is needed to speed the machines of war. Laying a corduroy road to facilitate the movement of heavy equipment over a river bottom.

Engineers in the Army

***Contents in Brief**—Both in combat and on the home front, the engineers of the Army are called upon to render a variety of specialized services. Col. George F. Lewis, chief of the repairs and utilities branch, Construction Division, U. S. Corps of Engineers, outlined the role played by the engineer in a recent address before the National Society of Professional Engineers. The following is an extract from his remarks.*

WITH WORLD-WIDE WAR upon us, we find ourselves utilizing all the varied services and talents of the engineer in the armed forces. On the home front he is helping to carry out another titanic campaign of building and production; on the battlefield, he is proving his worth in actual conflict.

Modern methods of warfare, popularly expressed in the term "blitzkrieg" have brought great changes to the military branch of the Corps of Engineers, as it has to all the other units of our armed forces. In mere numbers alone, our combat forces have expanded at a rate exceeded only by that of the Air Force.

But we have today more than merely a larger corps; it is, in effect, a new corps, new in equipment, in means of transportation, in technique, and in organization. We have, indeed, about 15 different types of engineer units today, each completely re-designed, in the light of lessons learned from the campaigns abroad and from maneuvers at home. Fundamentally, the purpose of the streamlined Corps of Engineers of 1942 is the same as that of their brothers of the past—to make the going easier for our own troops and tougher for the enemy. However, modern mechanized warfare has introduced new methods and machines that have made the military engineer more of a specialist than ever before.

The contrast between the engineer troops of 1918, for instance, and those of today is arresting. In 1918 there was a "combat regiment" in every infantry division. That regiment, 2,000 strong, equipped with horses and mules, was a rather cumbersome organization, marching on foot and working mainly with basic hand tools. It conformed to the pattern of the time, and distinguished itself on many a field and in many an engagement, but it was far different from the small compact, mobile, hard-hitting engineer units today. As now organized, the modern engineer battalion of the United States Army contains but 750 men. It is completely mechanized, heavily armed, and equipped with many types of power tools.

The engineers who work with the Air Force are provided with special training and special equipment. The number and variety of the tools they carry for performing emergency services will surprise you. Altogether, the aviation battalion has as many as 220 pieces of heavy equipment and 146 vehicles. For the purpose of doing pioneer work, where speed is absolutely essential, they are provided with such equipment as motorized air compressors, diesel road-graders, concrete mixers, motorized well-drilling sets, heavy disk-plows and tractors, and other articles which emphasize the reliance of the modern army upon the use of machines. American inventive genius has contributed portable steel runways which can be laid down in unbelievably short time and provide safe and adequate landing fields.

It might be mentioned, parenthetically, that when these engineers have a job to perform, they are usually short on both time and material, and they have no blueprints to guide them in laying out their work. This, of course brings us to the crux of the whole situation, namely, that no matter how many machines we have nor how efficient they may be, they are useless unless they are placed in the hands of trained and competent personnel.

The experiences of the army engineers to date, in all theatres of operation, in all armies, have demonstrated the increased versatility and importance of their functions under the tremendously increased tempo of total warfare. The engineers are at once, builders and destroyers, experts in construction and in demolition, workers on both land and water.

The other side of the picture is presented by the new and vital task assigned our own engineer troops in building the pioneer road which will connect Alaska with the United States. Establishing bridgeheads under fire, and improvising emergency airfields in virgin territory; forcing roads through the jungle; throwing up defenses and laying mines; devising comouflage screens and building pontoon bridges; storming permanent fortifications with all the devices of modern war—these are all in the day's work for the combat engineer.

He is a Jack-of-all-trades in the primary trade of making war. All honor to him; when our final victory is achieved it will be due in great measure to his courage, initiative and ingenuity.

Engineers on the home front

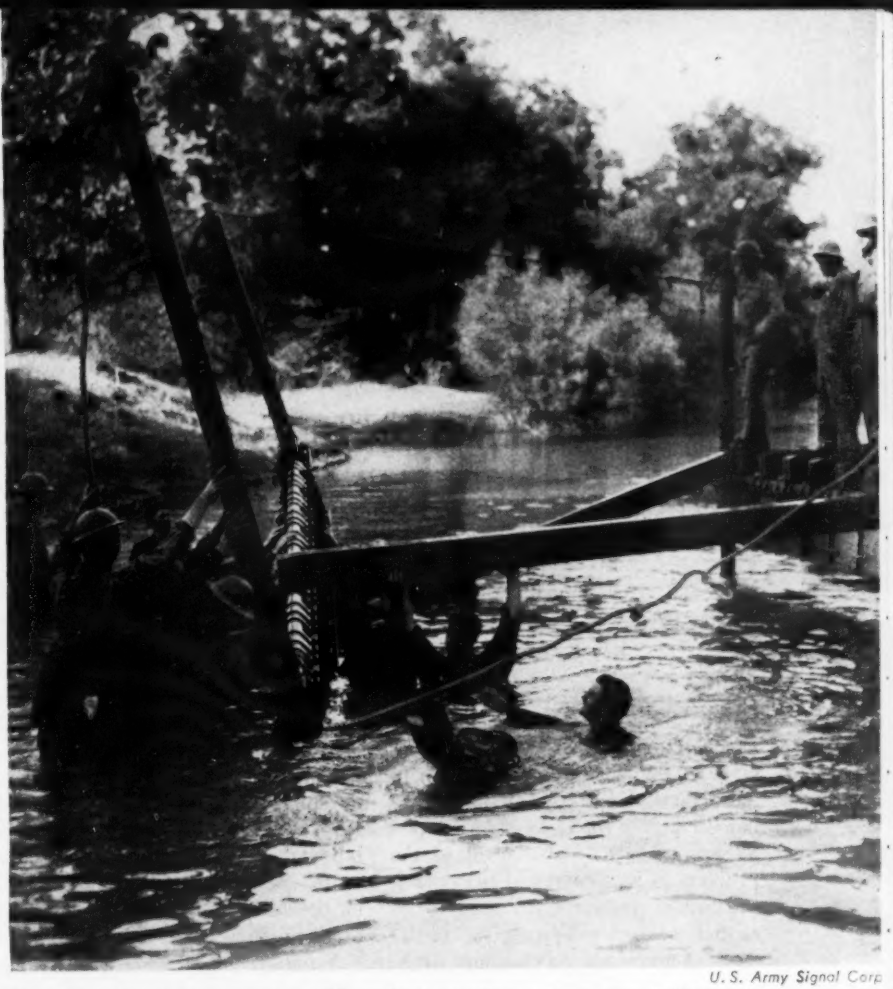
Activities of the Corps of Engineers on the home front embraces the emergency Army building program under the immediate supervision of Maj. Gen. Thomas M. Robins, Assistant Chief of Engineers, in charge of the construction division, which now approaches the tremendous volume of six billion dollars. More than half of this is already in place—completed.

In addition to its normal work, the corps is now responsible for the construction of all camps, airfields, storage depots, post and general hospitals, recreational areas, harbor defense, assembly plants, manufacturing plants and various other installations in this country and at all other places where such construction is needed.

The work varies from a small addition to a tent camp with its simple framed tent supports, to the most modern and completely equipped manufacturing plants covering acres of land with single structure; and the locations vary from the foothills of the ice-capped mountains of Alaska to the heart of the tropical jungles. We are building at locations 10,000 ft. above sea level and in the arid hot deserts, from next door to all the conveniences of our modern big cities to almost inaccessible outposts.

This brings me to the subject closest to my heart. When General Somervell asked me to take charge of the repairs and utilities branch of the Construction Division, I left a construction job in Haiti. That was about the first of February, 1941, just as the first of the new camps was being completed. So, I have had the privilege of creating the field organization for the maintenance and repair of all new construction and for the operation of the utilities connected with it. We take over the maintenance of any construction as soon as it is occupied by troops in any degree, and we maintain all of the many types of construction except the manufacturing and assembly plants and certain special storage and laboratory facilities.

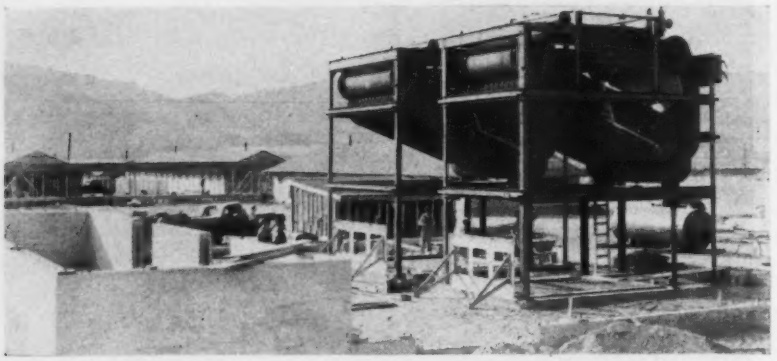
The maintenance and operation of these facilities includes far more than the continuing maintenance of



U. S. Army Signal Corps

Combat engineer troops get a stiff workout erecting a temporary bridge under conditions simulating "hell and high water".

Construction machinery is of prime importance to the work of the Engineers.



Installation and maintenance of heavy equipment, such as the boiler for hospital use as shown above, form part of the Army's engineering problems.

completed facilities. It also includes the completion of details of construction which were omitted because of premature occupation by troops. It includes minor adoption of the standardized designs of building to the particular area or location or needs of the occupying troops. It includes the modification of utilities to meet increased troop occupancy or unanticipated conditions developed by use. There is also involved the problem at new camps of organizing the entire maintenance staff from scratch and of procuring the initial stock of necessary material and parts.

Scope of utilities work

Some of the individual problems may be enumerated as indicating the scope of the work and the methods used in handling it.

Grounds—Erosion control is a major problem, thanks to newly-graded areas and lack of time for planting. With the very constructive help of the Soil Conservation Service, plus the use of a hundred or more CCC companies, we are pushing a program of planting and drainage that should gradually control this difficulty.

Roads—The incessant pounding of the thousands of heavily loaded military vehicles makes the maintenance of roads a major effort, and many deficiencies in provisions for culverts, ditches and shoulders must be remedied.

Runways—The increasing weight of bombers is causing failure in our older runways and we have yet to learn the full extent of our runway work. Complete snow removal from runways over a mile long and 300 ft. wide has led to some interesting developments in methods and equipment.

Space Heating—Both in the high-horsepower central plants and with the individual barracks heaters we find plenty to keep our staff of field combustion engineers busy. Fuel has been adapted to equipment and operators are being instructed, but the work yet to be done is infinite. In cooperation with the Weather Bureau we have developed degree-day statistics for ten different locations and for all types of structures. This will enable us to compute all fuel requirements on the basis of 1,000 sq. ft. of floor area per degree-day.

Supplementary Housing—A new and interesting problem of hotel management and grounds upkeep has dropped upon us at Miami, Fla., where the Army has already rented nearly 100 hotels for housing. We also determine the need for civilian war housing in connection with Army operations, take up requests for this housing with the federal housing agencies, and manage the housing on the reservations.

Sewage Disposals—The loading of disposal plants beyond their capacity limits is a problem which repeatedly comes up for solution. The nullifying effect of laundry waste and excess grease upon the treatment process has had to be met. After exhaustive research and experimentation adequate grease traps have been installed and a laundry waste treatment process developed.

Water Supply—Over-occupation of camps, added to dropping water tables, has brought up many problems of additional water supply and conservation of the existing supply. These have been met by curtailing the wastage of water with automatic flush valves, by conserving treated water through the use of surface water for vehicle washing, by the provision of trained technicians with the most complete equipment for detecting and locating leaks and by development of additional sources.

Waste Disposal—For the disposal of garbage we use both contract and incineration methods. We are now planning the more extensive use of sanitary fill for both garbage and waste disposal.

Fire Protection—Beside the problem of determining the need for fire equipment at each location we had to raise the industrial production of equipment to many times its normal amount. We have also had to employ and train the fire department personnel at all these locations. In this work we have received the invaluable aid of two officials of the National Board of Fire Underwriters who direct from our office and on our work a field force of 85 technicians operating from 50 locations. This without cost to the government except traveling expenses. We have helped design and install sprinkler systems in 60 hospitals and for 15,000,000 sq. ft. of warehouse space. At airfields we supply and man special crash trucks that must be at the field when planes take off or land.

Organization and personnel

The field organization for this repairs and utilities work consists of a small commissioned staff at each post under a post utilities officer. This staff is supported by an all-civilian staff of engineers, technicians and mechanics. Post utilities officers are under the technical supervision of a division utilities officer directing the work in nine maintenance areas which correspond to the corps areas into which the United States is divided for military administration.

In my office in Washington and in each of the division utilities offices, we maintain a staff of engineer specialists, inspectors and instructors. These men may be officers or civilians. In the interest of permanence we need civilians in all key positions. We are trying to build up a corps of maintenance and operating engineers in each of the broader fields of civil engineering, sanitary engineering, combustion engineering and so forth. We believe that the technique of maintenance and operation is one requiring the finest specialized engineering talent, and we are vitally interested in raising the standards of this profession.

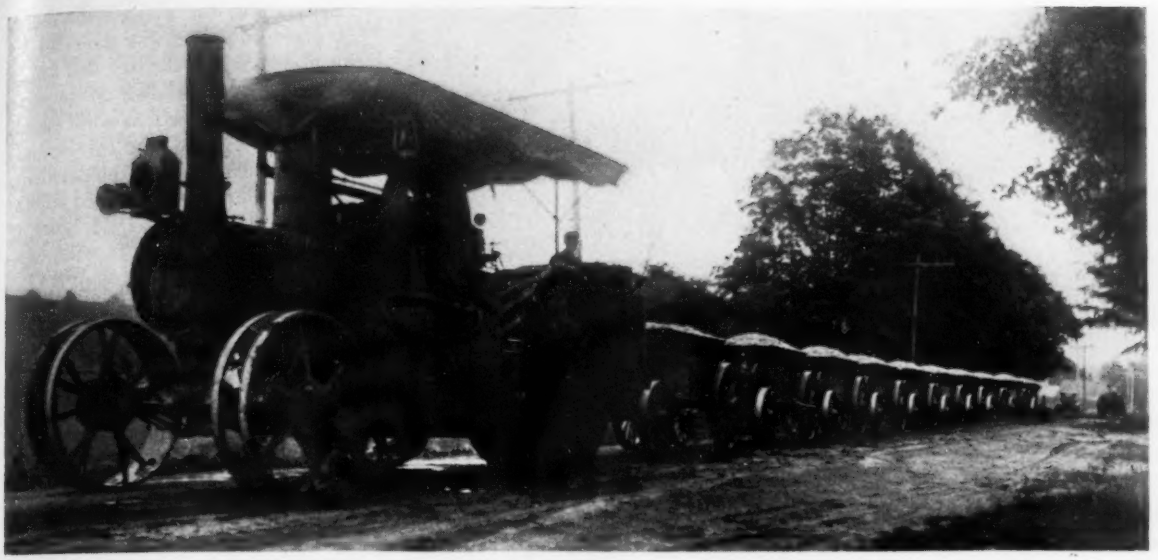


Fig. 1. On a 1912 project in Otsego County, N. Y., the contractor used a wagon train for hauling stone

Roadbuilding in the Good Old Days

Charles T. Fisher
Albany, N. Y.

***Contents in Brief**—Rapid advancement in highway construction during the past 40 years is clearly revealed by this account of road building early in the century. The methods of those days in constructing both macadam and concrete paving are reviewed and mention is made of the equipment used.*

DURING MORE THAN 35 years of highway work in New York state the writer has seen concrete and macadam paving practices develop from crude construction requiring much hand labor to the highly mechanized and precise work of today. Practices of 30 to 40 years ago are of special interest in that they reveal the rapid advancement in American highway engineering.

State highway work in New York from 1898 to 1909 was under the direction of the state engineer and there were three divisions instead of ten districts, as at present. Subdivisions were called residencies, and they sometimes included several counties. On his first highway job, which was in the summer of 1906, the writer was assigned by Frank M. Williams, then resident engineer at Goshen and later state engineer for many terms, to a paving project on the Fishkill-Hughsonville road in Dutchess County. The job was three miles of 14-ft. wide waterbound macadam extending north from Fishkill Landing, now Beacon. McNamee & Rice, Kingston, N. Y., were the contractors. Two seasons were required to complete the work—not an unreasonable record, considering the construction methods then in use.

All excavation was with picks and shovels. Nearby old walls provided a supply of good limestone rock for aggregate. For transportation to the contractor's crushing plant the stone was loaded by hand into two-horse, bottom-dump Watson wagons — the latest word in transportation equipment, although carts and pole-bottom wagons were still used. Cracked stone was hauled directly from the crusher, which was near the job, to the site where needed.

Fig. 2. In 1911, U. S. Route 20 west of Cherry Valley, N. Y. looked like this.

Stone for the macadam was spread by hand in two 3-in. thick courses. The bottom layer was filled with sand, but the top course was filled with stone screenings. The screenings were worked in by vigorous brooming and puddling with hand brooms immediately after the steam roller, which followed closely the horse-drawn water wagon (Fig. 3). No sub-base was used on this contract; the proposal for a 6-in. extra depth of run-of-crusher stone over a bad spot in the subgrade was refused by division headquarters as an extravagance.

Concrete for the culverts was mixed by hand on a wooden platform and placed with shovels (Fig. 4). Small quantities of sand for the concreting were obtained from nearby pits.

FIG. 3

FIG. 4

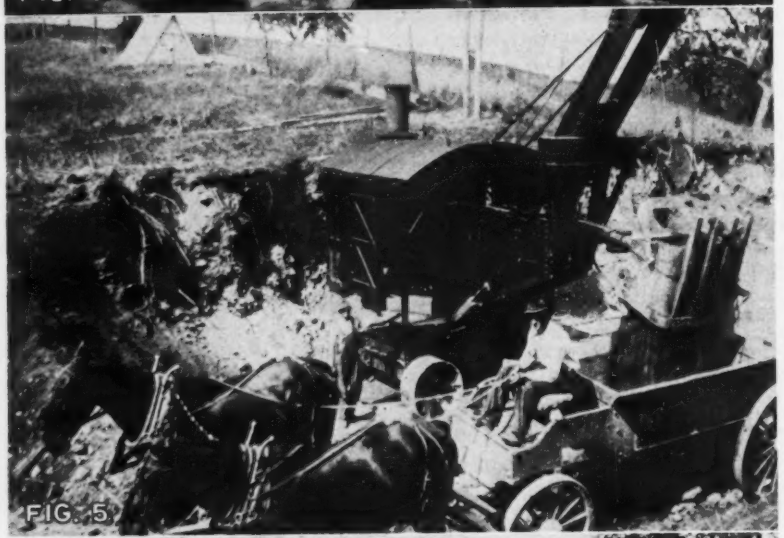


FIG. 5

FIG. 6

Excavation was a lump-sum item, but everything else was paid for at unit prices. Where the line and grade varied from those shown on the contract plans, cross-sections were taken, quantities computed, and corresponding adjustments made in the payment. This particular road cost about $9,000 a mile and lasted until 1925, when it was replaced with an 18-ft. wide concrete pavement.

Feathers tried as top course

As automobiles became more common and the dust more of a nuisance, highway engineers realized that the life of waterbound macadam would be short unless the fine material could be retained. To overcome this difficulty, many miles of road were oiled each season, but for a time it was difficult to decide whether the dust or the oil was the more objectionable. One state foreman, Monte Cone, after the tar had been spread through a small town called for a wagon load of feathers. This was spread on the completed road to "just make the job perfect." Repeated oilings built up many bumpy mats and for the first few years the oil spoiled as many miles as it saved. However, both road oils and methods have vastly improved since that time.

Soon after the first highway commission was organized, a low-cost design for light traffic roads in rural areas originated in the central part of the state. The West Exeter-West Winfield road built in 1911–12 in Otsego County was a good example of this type, which was built extensively.

Alignment followed the old road, so that the grading—all of which was done by hand—was light. Power shovels were a rarity on road work until a few years later; the first one that the writer saw was a steamer used by Law Brothers on the Wells Bridge-Otego job in 1912 (Fig. 5). Dirt was still hauled in horse-drawn

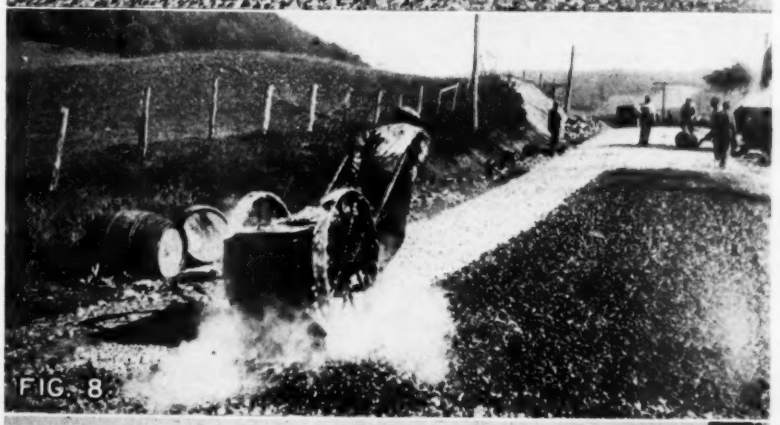
Figs. 3–6. Water bound macadam in Dutchess County was finished in 1907 by a broom gang following the steam roller and horse-drawn sprinkler (Fig. 3). Concrete for culverts on the same job was hand mixed (Fig. 4). One of the first power shovels to appear on highway work in New York was used by Law Brothers on the Wells Bridge-Otsego road job in 1912 (Fig. 5). Hand work still dominated in 1911, as shown in Fig. 6, where the sub-base of a 7-5-7 in. macadam is being laid. (All photos taken by the author.)

wagons, although the Lane Construction Corp. used steam tractors and rollers to haul wagon trains of stone from the railroad to its Schenevus-Westford job that same year (Fig. 1).

Pavement on the West Exeter road was 14 ft. wide and the roadway had a total width of 24 ft. Local field stone was used for the entire pavement and the 7-5-7-in. sub-base course was broken as it was laid (Fig. 6). Then the sub-base was filled with gravel and rolled. Directly on this course went the 2-3-2-in. thick top layer of crushed stone, which was filled with stone screenings and puddled. Then 0.7 gal. per sq.yd. of heavy hot oil was applied (Fig. 7) and immediately covered with ¾-in. stone and rolled. The cover stone broke up slightly under the roller, but a dense surface was formed and this proved to be quite durable. For this road, which cost about $10,000 a mile, Thomas Meehan & Sons, Philadelphia, were the contractors and Willard Sheridan, Richfield Springs, N. Y., the engineer. No resurfacing of the highway was required until 1931, nineteen years after the original road was built.

In 1911 the Cherry Valley Turnpike, now U. S. Route 20, was nearly all dirt road and not very good for motor travel, as shown by Fig. 2. This picture was taken between Cherry Valley and East Springfield while the writer was on an inspection trip with Paul McLoud, then division engineer at Binghamton and now engaged in mining at Ouray, Colo. The driver of the automobile is Joe Tanner, and he is still in state service and employed on taking test cores from new concrete pavements. Improvement of this section of the turnpike began in 1912.

About this time bituminous binders were being rather cautiously tried out, perhaps with reason, as some of the results were startling. If the binder was too soft, or if too much was used,



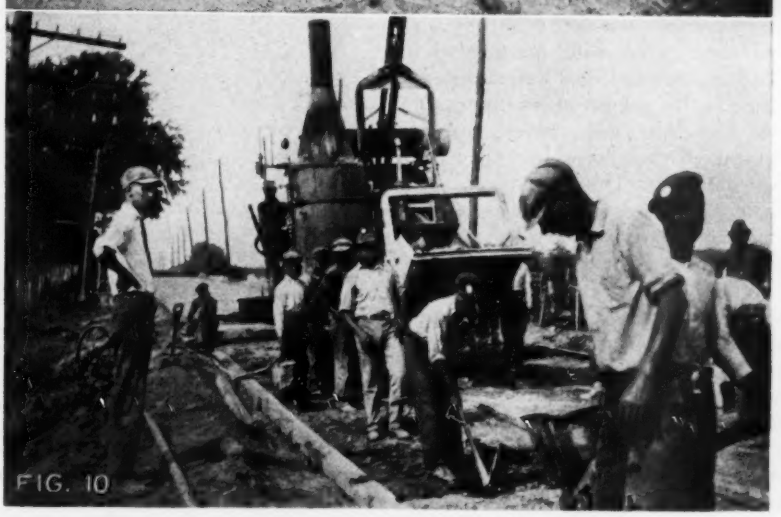


Fig. 7-10. "Hot-oil" for the job shown in Fig. 6 also was added by hand (Fig. 7), being covered with ¾-in. stone and rolled. Fig. 8 shows another hand method of applying hot asphalt. This road in Otsego County was built in 1911 at a cost of $13,000 per mile and was not rebuilt until 1929. In 1922 the steam pressure distributor shown in Fig. 9 was used for bituminous macadam in Sullivan County. By 1914 crude forerunners of the concrete pavers of today had begun to appear, as illustrated by Fig. 10.

it "bled" to the surface and caught dust, dirt, small stone fragments and even small animals. Traffic rolled the debris into cross ridges, and they immediately hardened into washboards that defied repair.

Asphalt was shipped in wooden barrels, heated on the road, and poured with hand pots, like the "hot oil." The first improvement on the hand sprinkler was a small two-wheeled distributor, drawn by man power (Fig. 8). With this equipment some good pavements were built, but a powerful man with several speeds ahead was needed to handle one of these machines, as the rate of travel had to vary with the temperature of the asphalt. Sometimes two men were needed. The work shown in Fig. 8 was on the Oneonta-Colliers road, in Otsego County. This highway was built by John Murphy, Cobleskill, N. Y., in 1911 and cost about $13,000 a mile. The route was rebuilt with concrete in 1929.

More expensive pavements

In 1913–14 more expensive pavement types, such as brick and cement concrete, appeared. Some of the first concrete pavements were of a 1-2½-5 mix, but richer mixtures soon came into use. Work in 1914 on the Scotia-High Mills road in Schenectady County is shown by Fig. 10. This 6-in. thick, 16-ft. wide pavement of 1:1½:3 mix was built by Wm. G. Fox of Saratoga Springs. M. L. Mackey now of Kansas City, Mo., was the engineer. The forms were of wood, and wooden joint strips were placed at 30-ft. intervals. Concrete was chuted from the paver to the sub-grade, and spread, screeded, floated and belted by hand. The surface was next broomed, just as it is at present, and then cured with moist earth. Crushed stone and sand were dumped ahead on the sub-grade, and batched into the skip with wheelbarrows. Cement, in cloth bags, was piled on the shoulders. This pavement cost about $15,000 a mile, and was rebuilt with concrete in 1938.

Some of the old concrete pavements, which were built with little or no reinforcement, have cracked badly and shown considerable wear after long service. However, they are noticeably free from the unexplained disintegration called scaling. With this in mind, the value of some recent refinements in material and manipulation becomes a matter for study.

High Temperature Recorded in Large Monolith of Concrete

TEMPERATURES up to 142 deg. F. were recorded in an 813 cu.yd. monolith of concrete placed in 29 hours for the Indianapolis Water Company's Oaklandon impounding reservoir dam. The monolith is 40 ft. long and 26 ft. high and is part of a 500-ft. long ogee-type overflow spillway.

The table shows the temperature recorded in the mass concrete and at the face, just under the wood forms. Surface temperatures of 90 deg. F. were recorded when the outside temperature was at 0 deg. F. Standard portland cement was used in this monolith. The remaining sections of the spillway were poured with a low-heat cement and in four lifts of 4½ ft., 5½ ft., 6 ft. and 10 ft.

The dam will impound about 7 billion gallons of water from Fall Creek in a reservoir 7 miles long and up to ¾ mile wide and will supply 30 mgd. of water for the commercial and domestic needs of Indianapolis. The 500 ft. long spillway section of the dam is designed for 50,000 cfs. discharge, considerably in excess of any recorded flow. The concrete spillway section is flanked by rolled-earth fill sections totaling 1,900 ft. long.

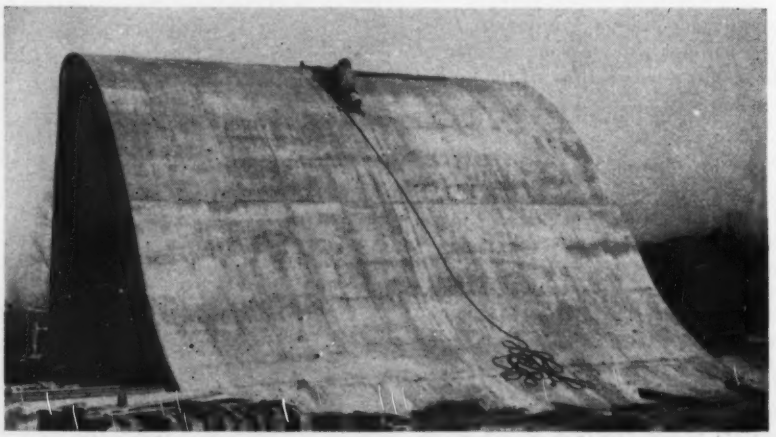
Design and supervision of construction of the dam was under direction of the late Charles H. Paul, of Dayton, Ohio, until his death and has since been carried on by C. C. Chambers, also of Dayton. Contractors for the work are Smith and Johnson, of Indianapolis.

CONCRETE TEMPERATURES

Age	*interior*	*face*
2 days	140 deg.	89 deg.
4 days	142 deg.	94 deg.
8 days	140 deg.	79 deg.
12 days	137 deg.	66 deg.
26 days	104 deg.	62 deg.

Forms were removed at 26 days.

The spillway and apron of the Oaklandon impounding reservoir dam of the Indianapolis, Ind. Water Company. The ogee section is 500 ft. long flanked by rolled earth fill section starting at abutment in the background.



This 40-ft. long, 26-ft. high section of ogee spillway was placed in one lift and generated temperatures up to 142 deg. F. despite prevailing winter temperatures.

Two lines of tents mark foundation construction operations along the walls of a large air depot supply building.

Fast Foundations in Frozen Ground

FACED WITH THE NECESSITY for winter construction of nearly 10,000 lineal feet of concrete building foundations at one of the nation's great air depots, the contractor sought and developed a procedure that, considering the difficulties, produced results at a rate comparable to the average for warm weather operations. Involved was the use of burning coke to thaw the ground for the excavators and the use of tents heated by salamanders to protect the work until curing was complete. As much as 900 ft. of foundation in a single line was under tent at one time.

Frost was as much as 5 ft. deep, and from previous experience it was decided that neither steam lines nor heated enclosures could be expected to remove this at the rate required. Furthermore some thawing method was desirable that would not complicate excavation by a power shovel equipped with a trench hoe. Burning a bed of coke laid along the foundation line was tried, and proved immediately successful. Procedure was to deposit the coke in a strip about 18 in. wider than the desired trench and to light this in the morning of the day before excavation was to start. Workmen replenished the fire as required, and in 24 hours the ground beneath was completely thawed.

The amount of ground that was thawed at any one time depended upon the amount of new excavation required to keep the form builders and concreting gangs busy. The maximum length of thawing was determined by the length of the tent that could be erected and heated in an 8-hr. day.

Unless the ground were to be allowed to freeze again it was necessary that the tents be placed immediately behind the trench-hoe excavator. These tents consisted of triangular timber frames over which tarpaulins were hung. Salamanders spaced about 25 ft. apart kept these enclosures above freezing, usually around 40 deg.

First operation under tent

First operation under the tents was to hand trim the rough shovel-cut excavation to exact pier and wall size. Carpenters followed closely behind this excavation work and, as soon as forms were complete, concrete was placed from truck mixers whose chutes were inserted through holes in the canvas. The mixer drum was charged with heated aggregates at the central plant, where the truck tank was also filled with water heated to 80 or 90 deg. The water was not added to the mix until the truck arrived at the site where the concrete was to be placed.

One wise precaution on the job was that no workman should be under the tent alone. Because of this requirement, there were no accidents from salamander gas, and because the tents were amply wide and high and under constant surveillance tarpaulin fires were not a problem. The tents were left in place for 14 days after the concrete was placed. Although extra costs were incurred and longer hours were worked than would have been the case in warmer weather, progress did not suffer because of the freezing temperature. And fast progress was the prime objective.

Tent frames were made up in units about 6 ft. long. Here an isolated pier is being excavated with a clamshell in contrast to the trench-hoe used for the continuous wall excavations.

Placing supports under the street car tracks was carried out on Sundays to avoid tying up traffic during business hours

Chicago Subway Station Street Decking

***Contents in Brief**—In an effort to relieve the congestion on surface and elevated transportation systems aggravated by war-time activity and a switch from private to public transportation facilities, Chicago is rushing the first link of its new subway to early completion. Recent major work has been the building of stations in open cut in the Loop section, where the tubes were driven with shields under compressed air. Four contractors used four different, but effective, methods in street decking, excavation and ground support. The stations are located in the center of blocks instead of the conventional corner locations in other cities.*

CHICAGO IS RUSHING the State St. route of its new subway to completion for possible operation late this year in order to relieve the pressure on other transportation systems created by increased industrial and business activity and the change from private to public transportation because of the tire situation. Principal construction operations in the past few months have been in building the subway stations. Four contractors, now completing these station structures in the Loop sections of the Dearborn and State St. routes had different ideas as to street decking, excavation, ground support and station construction procedure, but all proved effective with a minimum of inconvenience to street traffic and adjacent stores.

The subway tunnels through the Loop area are deep, driven by the shield method (*ENR*, Jan. 30, 1941, p. 158). They are of the center platform type, and platforms are mostly continuous from one station to the next. All Loop stations are located in the center of the block, instead of at corners as is the case in New York City, with stairway entrances on each side of the street leading to a mezzanine concourse below street level and above the top of tunnels. Stairways and escalators connect the concourse with the center islands platforms at train floor level.

Mezzanine concourse

The mezzanine concourse of each station occupies the entire width of street and extends under the sidewalk on each side for the width of the stairways from sidewalk level. Stairway entrances are all back of the curb line in the sidewalk area. In general the mezzanine floor is 17½ ft. below street level, and the island platform is 21½ ft. below the mezzanine. Two openings, each with a stairway and escalator, connect the platform and mezzanine. Change booths and turnstiles, service rooms and washrooms are at mezzanine level.

The main part of each station structure, consisting of steel framing with concrete floor, walls and roof, rests on the subway tubes. However, because of the soil condition—typical Chicago blue clay—and nearness to adjacent buildings, the outside stairway walls are carried on Chicago well caissons carried down to hardpan, about 60 ft. below street level.

The mezzanine station construction was done in open cut, using a combination of steel piles and wooden lagging to support the earth, buildings and traffic loads. Decking at street level was specified to permit maintaining pedestrian, vehicular and street car traffic during construction.

The soil conditions and network of underground utilities required a careful and cautious procedure. The first step taken by the contractors was to relocate all the sewers and sewer connections. Then an exploratory trench was dug in the line of the piles to be driven to locate the exact position of all utilities, after which the piles were driven and the decking placed and the utilities temporarily supported for the main work.

The spoil up to this point was carried away from the surface, but after access to the tubes below was accom-

plished, most of the spoil was carried away through the Chicago freight tunnel system as was the case in driving the tunnels. All of the decking then was placed, and it was only opened in places to provide access for forms, steel, concrete, and other materials to the work below, to maintain utilities and in some cases for excavation from the street level. Grated openings about 3 ft. square were left in the decking for ventilation.

Chicago union regulations do not permit use of ready-mix or transit-mix concrete so each contractor had to set up a concrete plant at every job. Once the decking and support were in place the construction of the station was largely routine, but considerable care was necessary in locating the deck support piling so as not to interfere with beams, columns or walls of the permanent structure. After the station structures were completed the facilities were replaced, and the space between the top of concourse and street level was backfilled.

State Street operations

For the State St. stations in general the excavation for the mezzanine was done in an area about 65 ft. square extending across the street. Two stair-escalator wells, each about 30 ft. long and 13 ft. wide, leading from the mezzanine to the train platform, were located in the center of the street, one on each side of the mezzanine station. Two sidewalk entrances about 8 ft. in width and an entry way to the mezzanine extended a distance of about 120 ft. on each side of the street.

Construction work in State St. will be described in detail according to each contract.

Anderson Co.—Two stations midway between Van Buren and Jackson Sts., and Jackson and Adams Sts., were built by the Robert R. Anderson Co. Features of this contract were the hanging of a system of ground support bracing from top beams to provide a clear working space below the struts, and the use of a tractor front-shovel for excavation.

Anderson placed the main stringers of the decking system longitudinal with the street. The deck supports consisted of 14-in. H-piles driven about 5 ft. apart. Lagging of 3x12-in. planking was placed between the piles as the excavation progressed and thus forming a temporary retaining wall. These piles, to which $\frac{3}{4}$-in. plates were welded at the top, supported the decking. Caps over the piles were 14-in. 78-lb. beams, and a set of stringers consisting of 30-in. beams were placed 3 ft. apart over the caps, parallel to the street and spanning the entire excavation. Sub-flooring of 4x12-in. planking and 6x12-in. top flooring, fastened to the large beams, completed the deck.

Most of the steel work was fabricated with bolts, but wherever the detailed design required stiffness and stiffening diaphragms, the connections were welded. Wales were, in general, 24-in. 80-lb. beams. Hanging from the top beams was a network of struts made up of 12x12-in. timbers, supported by $\frac{3}{4}$-in. round threaded vertical rods, and the struts stiffened by 12x12-in. vertical posts.

The general procedure after the piles were driven on the east side of the street was to place the decking on that portion of the street between the street car tracks and the east curb. The pavement in this area was removed and this part of the street was excavated just deep enough to receive the decking beams. Then over two weekends traffic was completely shut off and the piles supporting the decking under the street car tracks were driven. The decking was then placed supporting the street car tracks and traffic was resumed. The decking of the west side of the street followed.

Kenny Co.—The Kenny Construction Co. had two contracts on State St. for five stations between Adams and Randolph Sts. They also used 14-in. H-beam piles, but by placing a row of piles through the center of the excavation and at right angles to the street, they used lighter steel in the deck framing. On the contract north of Madison St. there were three street car tracks to support. However, only two were kept in service during construction and the third track served as a standby. After repaving of State St. it is expected that the third track will be omitted.

The outside retaining wall consisted of 14-in. H-beam piles from 5 ft. to $5\frac{1}{2}$ ft. apart, fitted with 3-in. horizontal lagging. The row through the center supported five spans of floor beams. The piles supporting each side of the outside spans and forming the retaining wall were driven through the construction hours of the week, and some excavation was done. Then over one weekend all traffic was cut off and the center piles were driven and decking steel was set. Street car traffic was resumed early the following Monday and after finishing the laying of the flooring all traffic was resumed early in the morning of the following Tuesday.

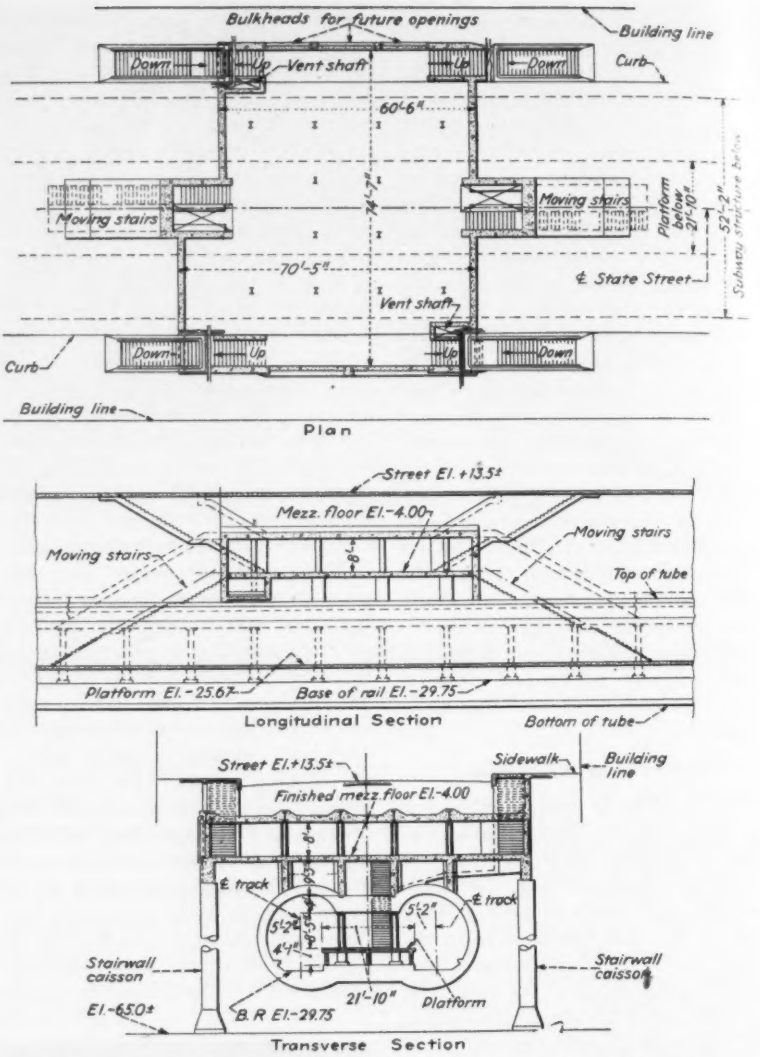
The floorbeams supporting the three inside spans were 18-in. 55-lb., from 10 to 14 ft. long. The stringers were, in general, 16-in. 58-lb. except those supporting the street car tracks,

Driving piles for the decking continued into the night to reduce the time of closing traffic lanes. All four contractors followed this practice.

which were 18-in. 77-lb. sections and were stiffened by 14-in. 30-lb. diaphragms fastened between each set of these stringers. The track ties and timber flooring was fastened to 6-in. wood nailing strips tied to the stringers by pencil rods and form clamps.

On the stations south of Madison St., this contractor employed a different layout for the decking. The same type of outside wall was used, but two rows of interior piles, supporting three spans of girders were driven just outside of the outside rails of the two street car tracks. Floorbeams supporting the car tracks were framed into these girders 16 ft. 7 in. apart and they, in turn, supported two rows of stringers. The girders were 27-in. 154-lb. sections, the floor beams were 16-in. 50-lb. sections and the stringers were 12-in. 40-lb. sections. The floorbeams spanning the excavation on each side of the street car tracks were 27-in. 163-lb. sections about 32 ft. long. These outside floor beams carried 12x12-in. wooden stringers 3 ft. apart, upon which 4-in. maple decking was placed.

Street car and vehicular traffic were stopped over two weekends while the piles were driven and decking steel was placed under the street car tracks. In both cases the outside piles were capped with 14-in. beams to support the floor steel. The beams connected to the inside piles were fastened by seat angles and welded connections. The retaining walls and interior piles were stiffened at two levels as the excavation progressed by 12x12-in. timber cross bracing.



Layout of stations in the Loop area, which are of the center platform type.

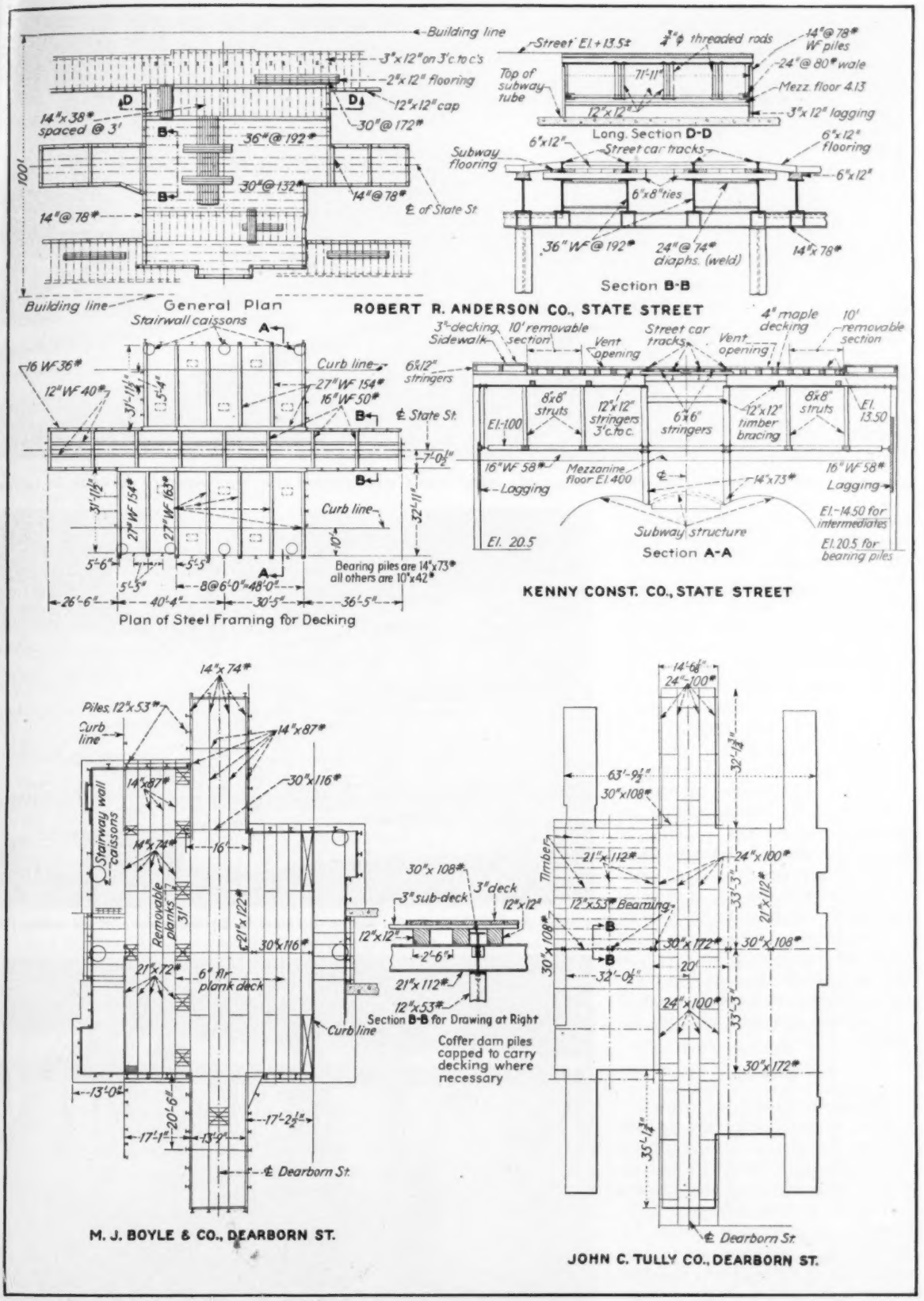
Dearborn Street operations

As Dearborn St. is considerably narrower than State St. the decking arrangements were somewhat different. The excavated area for the mezzanine proper extended across the street, about 50 ft., and was about 60 ft. wide. A stair-escalator well, 13 ft. wide and 30 ft. long was excavated on each side of the mezzanine section in the center of the street. These wells lead from the mezzanine to the train loading platform. The sidewalk stair entrances leading to a mezzanine entry-way were built on each side. This required an area to be excavated under each sidewalk about 8x120 ft.

Tully Co.—The large station between Randolph and Washington Sts. on Dearborn St. and the two Lake St. stations where the Dearborn St. route turns west, were built by the John C. Tully Co. On this work in general the temporary retaining walls were made up of 10-in. 43-lb. H-piles about 5 ft. apart, with 3-in. horizontal lagging supporting the ground. Along a line at right angles to the street and in between the retaining wall piles, approximately in the center of the excavation, more piles were driven 11 ft. center to center to support 21-in. 112-lb. beams that spanned the main excavation on each side of the street car tracks. These 12-in. piles were fastened at the top by a series of 30-in. 108-lb. beams running at right angles to the street. The street car tracks bore directly on 24-in. 100-lb. beams. All beams were set to bear on caps welded to the H-piles of the cofferdam. The flooring consisted of 12x12-in. stringers set 6½ ft. apart carrying a deck of 3-in. subflooring and 3-in. top flooring.

This contractor placed all of the north half of his decking in one operation, closing the street to traffic over one weekend during this part of the work and then placed the south half later, again closing the street to traffic over another weekend. Thus he worked clear across the street at one operation.

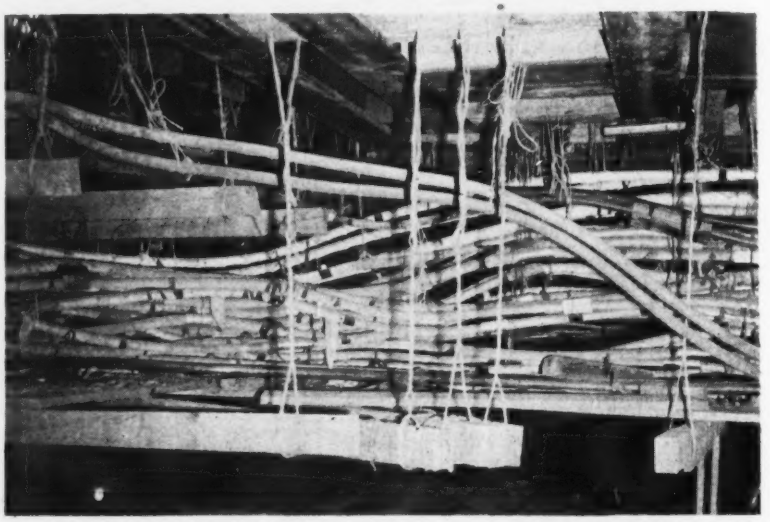
Boyle Co.—The M. J. Boyle & Co. had two contracts for five stations between Van Buren and Madison Sts. They used 12-in. H-piles with 3-in. lagging to support the earth and surcharge. The piles were driven to form three bays through the main part of the excavation, with the center bay supporting the two street car tracks spanned by 14-in. 87-lb. floor beams. The span of these beams was about 17 ft. Stringers 5 ft. center to center and spanning 20 ft. were also 14-in. 87-lb. beams.



Various types of deck framing and supports used by four different contractors to accomplish the same purpose on construction of the State and Dearborn Street routes of the Chicago Subway system. Although different in many respects each method of handling the problem proved equally efficient.

Excavating cranes rode the steel deck girders while motor traffic was diverted over the temporary roadway in center.

Piles for the center bay were driven and all decking was placed for this bay over the period of one weekend, thus closing off the street car traffic just once. The side bays and the side retaining wall were placed during the regular construction hours. All traffic was then served by the center bay until the remainder of the decking was placed and all excavation operations were in such a stage that they could be carried on completely below the decking. The street car tracks were carried on 7-in. ties; flooring between rails was 4-in. planks, resting on blocking over the ties. A 6-in. fir flooring was placed between the street car tracks and the curb. In all cases a sheeted trench was dug as early as possible to cut through the subway roof at the locations of the lower stairs and escalators in order to provide an outlet for the spoil. All decking and support were heavy enough to carry crawler cranes for handling the steel.



A maze of telephone cables was a problem to be taken care of on every job.

Long-span deck supports on one job permitted use of a tractor front-shovel in the hole for excavation work.

Direction

The subway stations are part of the subway system being built by the Chicago Department of Subways and Superhighways, for which Philip Harrington is commissioner, and Charles E. DeLeuw is chief engineer. V. E. Gunlock, as construction engineer for the Subway Commission was in general charge of station work. Resident engineers included J. Walter Grimm, Harry Bartz, C. A. Benowicz, R. A. Bonnell, B. C. Metros and W. S. Scott.

Vibration Periods of Structures

H. M. Engle
Structural Engineer, Board of Fire Underwriters of the Pacific
San Francisco, Calif.

***Contents in Brief**—The necessities of earthquake design make a knowledge of vibration characteristics of structures very important. Hitherto largely unavailable, such data have been gathered in the past few years by the U. S. Coast and Geodetic Survey by measurements on a large number and variety of structures. Periods vary with bracing, height, foundation and shape of structure. A low period, 0.7 or less, is indicative of strength and rigidity but, depending upon design or quality of construction, even low-period structures may be damaged in earthquakes. This article represents the first compilation of these vibration data in a form usable by the designer, and covers both buildings and elevated water tanks.*

COMPREHENSIVE DATA on building vibration characteristics, long desired by engineers, have been made available by the U. S. Coast and Geodetic Survey, through an extensive program of measurements carried on for several years, involving many kinds and types of structures, and including a number of structures in various stages of completion. In most of the structures, measurements were made with light or moderate winds acting, and amplitudes of vibration were small. Some studies were made with vibration induced in the structure by an eccentric revolving wheel of considerable mass; by varying the speed of rotation, points of synchronous response in the structure could be studied. In general, the periods parallel to the major axes have been determined. In some cases, instrument set-ups at several points in the height or at several locations in a given story were made. Synchronized set-ups in adjoining buildings were made in one experiment.

In none of the measurements made was the vibration sufficiently severe to break the bond or friction between the various component parts of the structure such as walls, partitions, frame and floors. This is an important point to note because in an earthquake, as a structure is progressively loosened up, its period would vary. With a skeleton frame building, as the damping action of the internal friction between walls, partitions and floors is destroyed, the period might end up by reaching a value close to that of the skeleton frame itself. On the other hand, a well-braced structure in which damage would be nominal should go through a heavy shock without any appreciable change of period.

The instruments used in making the measurements were all developed by, or in collaboration with, the U. S. Coast and Geodetic Survey. Their accuracy is of a high order, and all measurements were made by skilled observers of long experience in this type of work.

Table 1 gives representative figures for buildings representing a wide variety of heights, sizes and shapes. For the figures to be of practical value, it is necessary to correlate them with the known structural characteristics of the building in question, and the following observations concerning the various buildings in the table are presented with that fact in mind.

Vibration periods of buildings

Buildings Nos. 31 and 33. These low structures, designed for housing purposes, show great rigidity. No. 31 is a fairly typical wood dwelling, and the general strength and stiffness of well-constructed wood dwellings has been demonstrated many times in earthquakes. No. 33 has a welded steel stud frame and was braced for 0.1 g.

No. 27. Period parallel to long wing is less than that parallel to short wing.

No. 28. The period of this building is somewhat less than those of 24, 26, and 27, probably due to the stiffness of the reinforced walls used in 28. All stiffness in 24, 26, and 27 has to come from wind bracing in the frame.

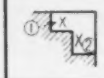
No. 34. The five reinforced-concrete cross partitions markedly increase stiffness in a N-S direction.

Nos. 16, 17, 18, 19 and 20. All about same height (150 ft.). No. 18, designed for 0.1 g., and 20, also designed to resist shock, have periods shorter than 17 and 19, which are not braced to any extent. No. 16, with reinforced-concrete walls, has a period about the same as 18 and 20. The stiff steel frame bracing of 18 and 20 gives much the same effect as the bracing furnished by the concrete walls. The brick walls of 20 are reinforced.

Nos. 18 and 32. Both have about the same period. The bracing in 18 and its reinforced-concrete walls are known to be dependable and of excellent quality. No. 32 is an early-day example of reinforced-concrete design, and the quality of the concrete and detail of reinforcing are known to be questionable. No. 32 depends on its concrete walls for stiffness. Both buildings appear to be about the same. Without question, however, the walls and frame of No. 32 would crack and loosen up in the early stages of a severe shock, and in a long shock, collapse would be possible. No. 18 would probably survive any severe shock, with minor damage. The two structures show vividly that comparable periods do not necessarily indicate comparable behavior in a given shock, unless the quality of construction and design in both are comparable.

Nos. 23 and 25. Both about the same height and type, although differing in shape. It is the writer's opinion that the longer period of 25 is possibly due to loosening up of walls and partitions in the Long Beach shock of March 10, 1933.

Table 1. Comparative Vibration Data on Typical Structures of Different Types

No.	BUILDING TYPE	FOUNDATION DATA	HEIGHT (FEET)	SHAPE	PERIOD N-S	PERIOD E-W	REMARKS
1	16 story—steel frame brick panel walls.	Sand and clay.	219		1.13 (X1) 1.11 (X2)	1.34 1.34	Frame braced for 20 lb. wind.
2	4 story — steel frame rein. conc. walls.	Wood piles. Uniform soil at site not deep, and of small area.	74		0.43	0.37	Rear walls no openings. Glass 80% in 1st story on sts. Frame not braced. Stiffness due to walls.
3	13 story—steel frame conc. walls (brick faced).	On piles in deep alluvial soil.	175		1.20 15th 1.21 13th 1.16 5th	1.31 1.30 1.31	High 1st story designed as a flexible frame.
4	Memorial Tower. Rein. conc. walls and frame. Tubular shape.	Shale rock.	373		0.4	0.4	No wall openings.
5	Memorial Tower. Steel frame, conc. walls, stone faced.	Conc. mat on sand, gravel. Mat 48' sq. 8' thick.	287		1.20	1.20	Stone facing adds to mass. Frame braced for 20 lb. wind. Alternate tiers braced. Conc. walls 8".
6	3 story—steel frame. Brick walls, granite faced.	On sand.	78		0.38	0.36	Frame not braced. Library with high stack rooms.
7	5 story—steel frame. Brick walls, granite faced. Federal office building.	On sand.	85		0.37	0.30	Frame braced for 15 lb. wind. Large area. Heavy walls. Note closed shape.
8	8 story, rein. conc. frame, floors, walls. Wall openings moderate. Dormitory.	On sand and gravel.	82		0.25	0.23	Massive structure very rigid. Wings do not complicate vibration characteristics.
9	Steel frame, concrete walls and floors. Court House.	Sand and clay ftgs. inter-connected.	210		Compl-Bldg. 0.55 Steel frame 1.22	0.51 1.13	Designed for 0.2 g. Note regular shape and set backs. Walls take most of lateral forces.
10	6 story with 4 story wings. Welded steel frame. Walls conc. with stone facing.		90		0.43	0.48	Braced for .08 g.
11	8 story, steel frame, brick walls.		120		0.74	0.77	Frame braced for wind only. Many tile partitions.
12	14 story, steel frame, brick walls, conc. floors.	Alluvial soil.	222		1.3	1.3	Frame braced for wind only. High 1st story (30') Many tile partitions.
13	10 story—conc. frame and floors, brick and conc. walls. Office Bldg.	Alluvial soil.	180		0.97	0.74	Frame braced for wind only.
14	15 story—steel frame brick walls, conc. floors. Office bldg.	On sand.	196		1.25	1.33	Sq. tower. Frame braced for 15 lb. wind. Many tile partitions.
15	12 story, steel frame, conc. walls and floors Apt. house.	On shale and sandstone.	174		1.20	1.11	Narrow bldg. conc. walls have moderate openings. Frame braced in E-W direction for 15 lb. wind.
16	12 story, concrete frame and floors. Walls rein. concrete.		150		0.75	0.53	Narrow building. Rigid. Negligible damage in Long Beach shock, Mar. 10, 1933.
17	12 story, concrete frame and floors. Brick walls. Office building.	Alluvial soil.	150		1.14	1.00	Bldg. damaged in Mar. 10, 1933 shock. Not braced for wind or earthquake.
18	12 story, steel frame, concrete walls and floors.	On rock.	150		0.65	0.78	Braced for 0.1 g. Frame bracing heavy and rigid.
19	12 story, steel frame, concrete floors, brick walls.		150		1.42	1.41	Not braced for wind or quake. Considerable damage in lower 4 stories, in Mar. 10, 1933 shock.
20	11 story, steel frame, rein brick walls.	On piles, at original bay shore.	157		0.70	0.75	Frame heavily braced. Deep spandrel trusses, and knee braces. Built after 1906.
22	9 story, concrete frame and floors, brick walls.		125		0.70	0.78	Not designed for wind or quake. Continuous frame gives stiffness however.

Note. In column headed "Shape", shading indicates adjoining buildings, numerals show number of stories and "X" is point where instrument was set up.

Nos. 3, 13 and 14. These are about the same height. Note that the concrete frame building, No. 13, has a considerably shorter period than the steel frame buildings, Nos. 3 and 14. This is probably due to the fact that the concrete frame is designed for some continuity between beams and columns, while the standard connections in the steel frames do not give this stiffening continuity.

Nos. 9 and 18. Both designed for heavy lateral forces. Periods are low, but No. 9, with reinforced-concrete walls designed to take nearly all the load, is a little stiffer than No. 18, where the steel frame was designed to take most of the load.

Nos. 16 and 17. No. 16 has a much shorter period than 17, probably due to its stiff reinforced-concrete walls and frame. No. 17 has masonry walls and an unbraced steel frame, and was considerably damaged in the Long Beach shock of March 10, 1933. No. 16 was undamaged in this shock.

Nos. 3 and 4. While of the same height, they are quite different structurally. The rigid tube on rock, No. 4, has a period of about one-third that of No. 3, a steel frame structure on deep alluvial soil.

Nos. 4 and 5. Bracing in No. 5 is relatively less in proportion to the mass and inertia than in No. 4. Note different soil conditions.

Nos. 2 and 6. These buildings are the same height and of about the same periods. The brick and stone walls of No. 6, lacking tensile strength, would probably go to pieces in a severe shock, while the reinforced walls of No. 2 would probably suffer much less damage.

Nos. 2, 6, 7 and 8. All are about the same height (80 ft.) and have large floor areas. Note period variations. No. 8, with extensive reinforced-concrete walls and moderate openings, is the stiffest and probably would suffer least in an earthquake. (There are many existing shrinkage cracks in No. 8.)

Nos. 1, 3 and 9. All about the same height. Periods of 1 and 3 are much greater than 9, which was designed for 0.2g. with reinforced walls.

Nos. 7 and 10. About same height and have large areas. No. 10 with welded steel frame and reinforced-concrete walls, was designed to withstand earthquake. No. 7 has an unbraced steel frame, with brick walls and heavy granite facing. No. 7 would probably suffer a great deal

more damage in a severe shock than No. 10, as its brick and stone walls would probably loosen up quickly with a consequent increase of period.

Nos. 6, 7, 11, 1 and 12. All are ordinary design, with brick walls, steel frames, and little or no bracing. Note period increase with increase in height.

No. 30, built in 1898, was loosened up somewhat in the San Francisco shock of April 18, 1906. Both walls and diagonal bracing were affected, although behavior of building was good in general. It is possible that the periods represent more nearly that of the steel frame than that of the complete structure as it existed before the shock. Note that later and higher buildings have smaller periods. Measurements taken before reconstruction of building to its present form.

No. 35, 210 ft. long, 48 ft. wide, is much stiffer lengthwise than crosswise. A transverse structural bracing wall or partition would have been desirable.

No. 37. Due to large diameter of tank in relation to water depth (144 ft. di., 26 ft. of water), the period is not affected by the water load. If water was replaced by a solid equivalent weight, or if tank were tall and narrow, the water load would affect the period. Water in relation to a shallow, large diameter tank is somewhat like the corn in relation to a popcorn popper.

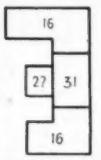
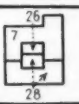
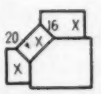
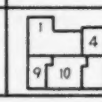
Buildings designed for earthquakes

Table 2 singles out those buildings from Table 1 known to have been designed for a lateral force of 0.1g. or more. The buildings range in height from 33 to 285 ft., yet the period range is only from 0.13 to 0.78. Excluding No. 33, the range is from 0.33 to 0.78, a small variation.

TABLE 2. PERIODS OF BUILDINGS KNOWN TO HAVE BEEN DESIGNED FOR A LATERAL FORCE

Bldg.	Height (Stories)	Periods N-S	Periods E-W	Remarks
33	33	0.14	0.13	2-story, welded steel frame dormitory
34	75	0.33	0.50	Factory building, several concrete bracing walls
36	80	0.27	0.20	U. S. government building
8	82	0.25	0.23	Large arer, many walls
10	90	0.43	0.48	Welded steel frame
37	100	0.29	0.29	Tubular concrete tank tower
41	120	0.45	0.41	Hotel
18	150	0.65	0.78	Office building
4	173	0.4	0.4	Tubular concrete memorial tower
9	210	0.55	0.51	Symmetrical set back architecture
29	285	0.74	0.77	Tower structure

Table 1 — Continued

No.	BUILDING TYPE	FOUNDATION DATA	HEIGHT (FEET)	SHAPE (N, W, E, S)	PERIOD N-S	PERIOD E-W	REMARKS
23	31 story, steel frame, brick walls. Office building.	Hard sand and clay. Continuous mat under tower.	409		1.72 (30th) 1.76 (22nd) 1.72 (16th N.E.Cor.) 1.74 (16th end N. Wing) 1.76 (16th S.E.Cor.) 1.74 (16th end S. Wing)	1.92 1.90 1.95 1.90 1.89 1.90	Frame braced for 20 lb. wind.
24	29 story, steel frame, brick walls. Office building.	On caissons to stiff clay.	381		1.91 29th 1.90 20th 1.91 10th 1.91 5th	1.87 1.92 1.89 1.92	Frame braced for 20 lb. wind. Square tower.
25	25 story, steel frame, brick walls. Office building.		400		2.28	2.33	Tower structure. Frame braced for 20 lb. wind. Considerably loosened up and cracked in Mar. 10, 1933, shock.
26	26 story, steel frame, brick walls.	Sand and clay.	369		2.20	2.25	Frame braced for 15 lb. wind, mostly in wing ends. Wings slender.
27	21 story, steel frame, brick walls. Office building.	At ancient bay shore.	309		1.8	1.5	Frame braced for 15 lb. wind. Wings narrow.
28	28 story, steel frame, rein. conc. walls. Office bldg.	Firm sand and clay.	340		1.36 28th 1.35 20th 1.39 10th	1.55 1.56 1.57	Concrete walls add strength and stiffness.
29	16 story, steel frame, conc. walls. Library.	Solid mat under tower. Sand and gravel.	285		0.74	0.77	Steel frame braced for 20 lb. wind. Bldg. as a whole braced for about 0.1 g.
30	19 story, steel frame, brick walls, stone faced.	On sand. Solid mat under bldg.	266		2.20	1.95	Built 1898. Steel frame braced for 50 lb. wind. Walls loosened up somewhat in 1906 shock.
31	2 story, wood frame dwelling, wood sheathing, shingled.		25	Square.	0.21	0.20	Fairly typical of all wood dwelling on conc. foundations.
32	8 story, concrete frame, floors and walls.	On piles in deep fill	100		0.70	0.80	An early building. Quality of design and conc. questionable.
33	2 story, steel studs. All welded. Stucco exterior. Dormitory.	On sand, clay. Conc. foundation.	33	Long narrow wings.	0.14	0.13	Braced for 0.1 g. Stiff rigid structure.
34	3 to 5 story, steel frame, conc. walls.	On piles in tidal flat.	75		0.33	0.50	Braced for 0.1 g. 5 conc. division walls across bldg. Undamaged in Mar. 10, 1933, shock.
35	7 story, conc. frame and walls. Hospital.	Clay and rock.	85		0.26	0.55	A rigid structure. Wall openings moderate.
36	Steel frame, conc. floors, walls (Granite faced). Federal bldg.	Rock.	80		0.27	0.20	Braced for 0.1 g. Rigid bldg.
37	Con. tank tower, circular walls, 144' dia. Walls solid to ground.	Hardpan.	76' to floor 100' to top of walls		0.29		Period about same for tank full or empty. Braced for 0.1 g.
38	Steel frame tower, wood and stucco exterior. No floor loads.	On piles in fill.	369	Octagonal tower.	Complete 1.70 Before carillon was placed 1.53	1.70 1.53	Ornamental tower. 50 ton carillon at top.
39	13 story, steel frame, walls, terra cotta faced.		150		1.17	0.92	Narrow wings. Frame not braced.
40	20 story, steel frame, brick walls. Hotel.	Rock	240		East. Wing 1.35 South Wing 1.35 Center 1.35 S.E. 1.02 N.E.	1.35 1.35	Frame baced for 20 lb. wind. Kneebraces used.
41	9 story, conc. frame, and walls. Hotel.	On conc. piles in deep alluvial soil. Footings interconnected.	120		0.45	0.41	Braced to resist shock.

Note. In column headed "Shape", shading indicates adjoining buildings, numerals show number of stories and "X" is point where instrument was set up.

TABLE 3. PERIODS OF TALL STEEL WATER TANK TOWERS

No.	Tank cap. (gal.)	Tower ht. (ft.)	Bracing design	Period	Condition of bracing rods	Remarks
1	100,000	100	100 mi. wind	1.58	Tight	Tank full. On piles
2	100,000	100	"	1.61	Rods very loose	On firm ground
				1.44	Rods tightened	
3	100,000	100	"	1.56	Tight	On firm ground
4	100,000	100	"	1.70	Tight	On piles in deep alluvium
6	100,000	100	.08 g	1.30	Tight	On firm ground
7	100,000	100	100 mi. wind	1.43	Tight	On clay
8	100,000	100	"	1.59	Some loose, some tight	Firm soil
				1.46	All tight	
10	75,000	100	"	1.45	Variable tightness	On clay
11	75,000	100	100 mi. wind	1.60	Not very tight	On piles in filled ground
			0.12 g	1.10	Tight	
12	50,000	100	0.1 g	1.11	Tight	On piles in marsh land
13	50,000	100	0.1 g	0.95	Tight	On clay
14	50,000	100	.08 g	1.22	Fairly tight	On clay
15	50,000	100	.08 g	1.23	Tight	On piles in filled ground
16	50,000	100	100 mi. wind	1.33	Tight	On clay
17	50,000	100	"	1.32	Not very tight	On clay
19	50,000	100	"	1.26	Tight	On clay
20	50,000	119	100 mi. wind	1.44 and 1.32		Two tanks on one tower
	25,000 below	(top tank)	0.1 g			
21	50,000	64	100 mi. wind	1.22 and 1.07		On two-story concrete building
			0.2 g	0.74 and 0.80		
22	50,000	83	100 mi. wind	1.04 and 1.07		Some rods loose
			0.1 g	0.94 and 0.91		
24	50,000	74	0.15 g	0.89		On piles in marsh ground
31	50,000	50	0.15 g	0.70		Flat-bottomed wood tank on steel tower
32	100,000	125	.08 g	1.16 and 1.20		
35	200,000	100	0.1 g	1.06		6 col. tower

The writer wishes to emphasize again that, while buildings of earthquake resistant design (0.1g. or more) have rather small periods, a small period does not always indicate a high degree of earthquake resistance. *Before a small period can be said to indicate a high degree of earthquake resistance, it must be correlated with the design and quality of construction.* This should not be overlooked. Buildings 7, 11, 22 and 32 have periods close to the upper limit of periods in Table 2, and No. 6 has a period of about 0.38, yet experience in past shocks has shown that buildings of these types are highly susceptible to damage, due to lack of bracing and unsuitable combinations of materials.

It can be said, however, that a low period of 0.7 sec., or less, is usually indicative of strength and rigidity. It can also be said that a large period, 1.0 sec., or more, is usually indicative of a lack of bracing and lateral strength. Whether or not it may also indicate flexibility rather than lateral weakness is an argumentative point on which the writer makes no positive statement. Each individual will have to satisfy himself on the merits of this possibility.

The periods tabulated are the maximum periods of structures and are dominant in most cases. In nearly every structure, other periods were observed. Long narrow wings in some cases appear to have periods of their own mixed in with the general dominant building period. Simultaneous measurements, made in adjoining buildings in contact, showed that periods are transmitted from one building to adjoining buildings. Those interested in all of the details of the various measurements should consult the records in the office of the U. S. Coast and Geodetic Survey in San Francisco.

Periods of tank towers

Tall tank towers are common and their action under earthquake vibration is also a subject of structural interest. Table 3 gives data on tank towers similar to that given for buildings in Table 1. D. S. Carder of the U. S. Coast and Geodetic Survey, in "Observed Vibrations of Steel Water Towers," has summarized the conclusions to be drawn from the data so clearly that he is quoted as follows:

"Additional bracing effectively reduces the period of the tower, and the greater the amount of bracing the greater the reduction of the period. Compare the periods of towers 6, 11, and 12 to 15 with the periods of other towers in the respective groups. Compare also the periods of towers 12 and 13 with those of 14 and 15.

"The period of a tower having loose tie rods is reduced if the tie rods are tightened. If the tension in the tie rods is uniform throughout, the period is probably the same in directions at right angles. A difference in period in the two directions has been observed where some of the rods have been slackened prior to being reinforced. (See Table 3.)

"Towers on yielding ground where piling is required usually have a greater period than towers on firm ground. However, there is strong evidence that some of the piling we are dealing with has been driven through compact material. For example, the Port of Oakland tower rests on piling driven through hydraulic fill. If comparative periods of water towers can be relied upon, it seems that this fill is relatively compact."

A further proof of the effectiveness of bracing tall steel towers for lateral forces of 0.1g. or more, was furnished in the Imperial Valley, Calif., shock of May 18, 1940. There were eight tall towers in the valley. Two of them, one new, designed for 0.1g., were undamaged. Of the six remaining wind-braced towers, two were total collapses and four were badly damaged, with stretched or broken bracing rods.

The periods given in Table 3 were all measured with the water at rest. It is a known fact that wave action develops in the tanks under the more severe vibrations of an earthquake, and this would probably change the vibration characteristics of the tower materially.

All data tabulated were taken from the records of the U. S. Coast and Geodetic Survey. The vibration measurements were made under the direction of Franklin P. Ulrich, with D. S. Carder in charge of the instrumental field work.

Septic Tank Drains Are Not Clogged by Roots

Based on the report that roots seldom clog the effluent drains from a septic tank, as they rather frequently do in ordinary sewer laterals, inquiry was made from a number of sanitarians as to why this is true. Confirmation was forthcoming promptly. The general belief is that even where roots have attempted to enter the outlets from septic tanks there has been no record of serious clogging. Rather, the roots tend to rot off, and very rarely do they grow into the drain.

The reason ascribed is that in order to grow and develop, roots and plants must have oxygen. In sewer laterals, the amount of oxygen present is relatively high. The more septic the sewage becomes, the less there is of dissolved oxygen and the less likelihood of root growth.

Concrete Pumped Downhill for a Dam

Charles M. Glines
Superintendent of Construction, Benjamin Foster Engineering Co.
Philadelphia, Pa.

***Contents in Brief**—At York, Pa., a pump and pipeline system was used to distribute the 40,000 yd. of concrete required at widely separated points for control works of the earth and rock Indian Rock Dam. Moderately dry concrete was dropped 70 ft. in the pipeline without difficulty and it was pumped as much as 950 ft.*

PLACING CONCRETE for the control works of an earth and rock-fill dam presents unusual problems because the concrete ordinarily is used in relatively small quantities at separated areas and at differing elevations. For placing some 40,000 yd. in Indian Rock Dam at York, Pa., a pump and pipeline system appeared to be the most economical method to use, provided that it could be successfully adapted to downhill pumping. The job is now nearly completed, the pipeline system having been made satisfactory for this use by the simple expedient of venting the line at the top of the sharp drops.

Concrete with four and one-half bags of cement to the yard and a ½ to 3-in. slump was pumped as much as 950 lin. ft. The pipeline for the outlet tunnel and stilling basins (marked No. 2 in Fig. 1) ran out 250 ft. from the pump at a slight downgrade and then dropped 70 ft. straight down the control tower shaft. This line was used for placing concrete in the tunnel and was then extended through the tunnel to reach the buttresses and slab of the spillway stilling basin. The pipeline for concreting the upper end of the spillway dropped 40 ft. vertically 250 ft. from the pump and ran downgrade most of the way along the remainder of its 950-ft. length.

Impervious earth and rock fill

Indian Rock Dam is an earth and rock-fill structure on the main branch of Codorus Creek about four miles southwest of York, Pa. The dam is an impervious, select earth-fill embankment, with graded rock spalls covered by dumped rock fill on which the surface was leveled by hand. Along the center line of the dam a core trench was excavated a few inches into solid rock and covered with 6 in. of concrete, placed with the pump and pipeline, in the section where the water pressure will be high. Where water pressure will be moderate 2 to 3 in. of shotcrete sprayed on the clean rock surface forms a seal course on which the earth fill was started. Rock for the protection courses was secured from the tunnel, spillway and other required excavation. The completed dam is about 1,000 ft. long at the crest, 460 ft. wide at the base and 82. ft. high.

The 40,000 yd. of concrete required for the project went into the seal under the dam, an outlet works for reservoir control and an overflow spillway channel, all of which were

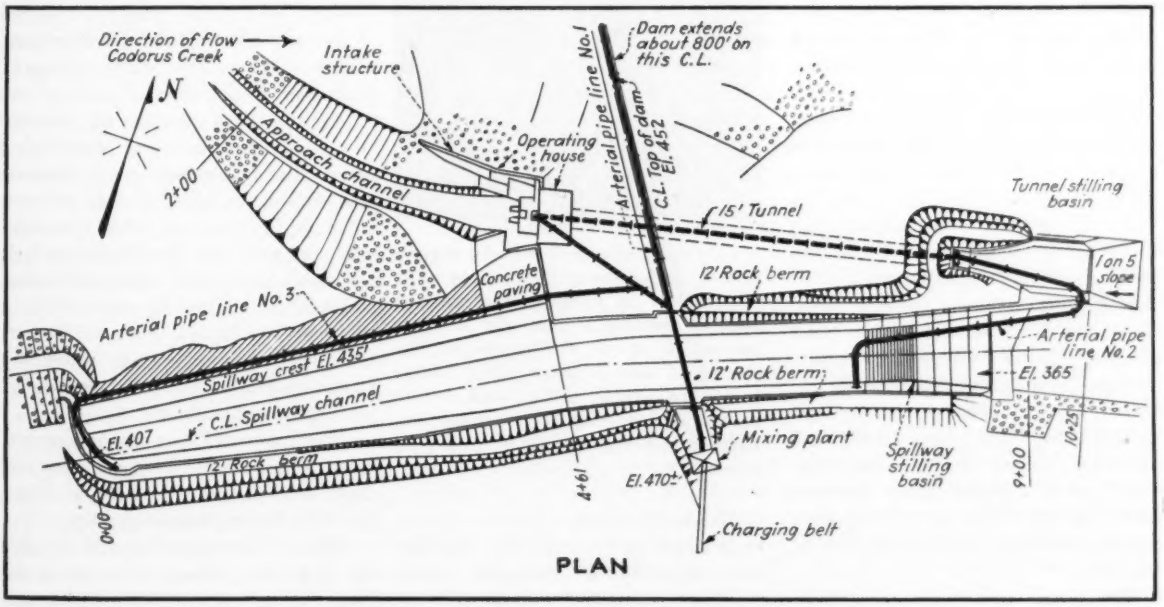


Fig. 1. Plan view of the concrete distribution system used in the construction of Indian Rock Dam. Concrete was pumped downhill and around the job through three 8-in. arterial pipes.

difficult to reach by truck or other means of transportation. The outlet works for normal streamflow (which served as the diversion channel during construction) consists of a 20-ft. wide approach channel about 500 ft. long, a concrete intake structure and control tower, a 15-ft. dia. concrete-lined tunnel 373 ft. long through the solid rock of the abutment and a downstream stilling basin. A concrete-lined side channel spillway, 17.5 ft. below the top of the dam, is located in a solid rock cut approximately at right angles to the dam. The overflow weir of the spillway is an ogee section of variable height and 461 ft. long. The spillway channel has a bottom width of 29 to 50 ft. and is paved with 2.5 ft. of concrete. The side walls of the channel are on a four to one slope and are lined to heights of 40 to 70 ft. with 2 ft. of reinforced concrete.

The pump and pipeline method of placing could be easily adapted to this construction as arterial lines could be laid to the general areas regardless of the terrain and distribution lines added as specific forms were ready for concrete. A double cylinder concrete pump was located under two left and right-hand rotating 1-yd. non-tilting mixers. These machines were supported on a separate foundation directly under a 64-yd., four compartment, combination aggregate and cement bin. The latter was equipped with four-beam scales and weigh-batcher, a two-way chute for charging the mixers and a bucket elevator for hoisting bulk cement from bottom dump trucks. Aggregate reached the top of the bin by a belt conveyor. The mixing plant was located on the south side of the spillway channel, Fig. 1, and about 85 ft. vertically above the tunnel invert. All concrete was pumped from this plant through 8-in. steel pipelines laid out in three major arteries. At the forms the concrete was distributed by means of "elephant trunks" and short spouts, then vibrated into place. A signal system, consisting of a light travel cord with two-point contact and small bulbs on either end, was stretched between the forms and mixing plant so that the pump operator could be signalled by the concrete foreman to stop or start the flow at any time.

The pump was used successfully where the concrete dropped 70 ft. vertically and was then pumped a considerable distance horizontally or on a slight downgrade. Trouble had been experienced previously under similar circumstances, apparently by concrete entraining and then compressing the air by displacement inside the pipeline. The compressed air formed into pockets that traveled unpredictably along the path of least resistance through the filled pipe. In traveling the air apparently flowed in a channel over the concrete in the top of the pipe, broke the lubricating seal of grout and caused dry slugs that occasionally plugged the line. The surging action on a long down pitch of the line, brought about or aggravated by entrained air pockets, sometimes created a partial vacuum in the pipe that also caused dry slugs of concrete and consequently a lot of trouble.

Fig. 2. The concrete pump was set under mixers located below a 64-yd. four compartment bin. The pipeline crosses the spillway on the cable suspension bridge in foreground.

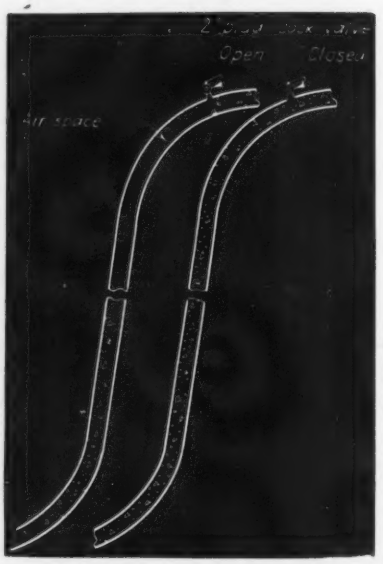


Fig. 3. Air vents or breathers tapped into the high point of the pipeline made it practical to pump concrete downhill. In starting a pour the valve is opened to permit the escape of displaced air and is closed when friction in the horizontal run of pipe at the bottom of the drop exerts enough resistance to completely fill the pipe with concrete.

Venting pipeline prevents plugs

A simple solution to the problem of entrained air was found in the use of a 2-in. nipple and plug-cock valve tapped into the top elbow of the drop pipe to serve as a vent or breather, as illustrated in Fig. 3. In starting a pour the valve was opened to permit the escape of displaced air and kept open as long as the drop pipe was not completely filled. As soon as enough resistance was built up by friction in the horizontal run of pipe at the bottom of the drop to hold the concrete until the pipe was filled completely, and resistance offered to the pump, the valve was closed. When starting a pour a batch of grout was pumped through the pipeline behind a tight wad of wet excelsior that served to keep the grout backed up enough to lubricate the full circumference of the pipe on the downhill section.

The pipe was plugged several times at Indian Rock Dam causing some delays. The plugs generally occurred at the start of a pour and in each instance when the air vent had not been opened or had been fouled from the preceding pour. Despite the difficulties encountered, the cost of pumping was well below the original estimate and less than one-half the estimated cost for any other method of concreting considered in the original layout. Cost of repairs for the concrete pump, including parts and labor, was 7c. per cu.yd. of concrete handled.

The mix used for mass concrete, natural sand and two sizes of gravel with a minimum of cement, is shown in the table on following page.

The double concrete pump handled a 1½ to 3-in. slump concrete of the mix at the rate of 50 cu.yd. per hr. or more. However, due to delays in moving between forms, shifting

spouts, etc., the average pouring rate was somewhat less.

Concreting operations started in August, 1940, with the core wall, tunnel, and some other structures being completed before the advent of cold weather. The tunnel was lined with 24 in. of concrete, the invert being finished before the barrel was started. Steel panel forms were used for the arch and were left in place 48 hours after the concrete placing was completed. The concrete discharge pipe was carried along the crown of the form, the end of the pipe being kept imbedded some distance in the fresh concrete to assure tight packing by pressure surges from the pump. Internal vibrators were used along the side walls.

MIX FOR MASS CONCRETE

Materials in 1-yd. batch		*Weight*
Cement (Standard Portland)		423 lb.
Sand	33%	1,160 "
¼–1" Gravel	38%	1,310 "
½"	29%	995 "
Water (26.3 gal.)		220 "

Cement = 1 Sand = 2.74 Gravel = 5.45

Cement per cu.yd. of concrete	4½ bags
Gravel-sand ratio	1.60
Specific gravity of gravel	2.58
Specific gravity of sand	2.64
Average slump	1½–3 in.
Mixing time	1½ min.
Strength—average in 28 days	about 3,600 lb.

Typical Sand Analysis — Percent Passing Screens

No. 4	98%	No. 50	15%
No. 16	60%	No. 100	1.5%

The ogee spillway was poured in 4 to 11½-ft. vertical lifts with joints at 20-ft. intervals across the section. The spillway channel lining was poured in checkered blocks 20x20 ft. Retaining walls were poured in alternate 20-ft. sections in lifts varying from 4 to 11 ft. in height. Curing was done with burlap covers that were kept wet for 14 days.

Placing concrete was ordinarily scheduled for three days each week. Pours were relatively small and the concrete crew was utilized on other operations, such as stripping and cleaning forms, moving pipeline, etc., until forms were ready for 300 to 450 yd. of concrete. The mixer plant crew consisted of one each of the following: belt conveyor operator, batcher man, mixer operator, concrete pump operator, concrete pump helper, a laborer loading cement and cleaning up, and a plant foreman. At the point of placing a foreman supervised the work of two men, each handling a one-man pneumatic vibrator, and four laborers shifting spouts, puddling concrete, and doing odd jobs. This made a total concrete crew of fifteen men who handled the entire concrete mixing and placing without the use of heavy machines or equipment other than the mixers and pump at the fixed location.

Indian Rock Dam is a flood control project of the Corps of Engineers, U. S. Army, and is being built under supervision of the Baltimore, Md., district. Lt. Col. C. P. Hardy is district engineer, and E. W. Digges, principal engineer at the district office. The construction is under the supervision of the York Area, A. E. Steere, senior engineer, area engineer, with James A. Stockley resident engineer.

Benjamin Foster Company, of Philadelphia was the contractor for whom W. F. Frantz was works manager during most of the construction and the writer was superintendent of operations.

Highway Link Across Australia Built Rapidly as a Defense Job

Closing the 620-mile gap in the middle of the Australian north-south transcontinental railway by means of a paved road was undertaken in 1940 by the commonwealth government in order to facilitate defense of the northern coast. During fifty years, by slow degrees, this railway line of 3-ft. 6-in. gage had been pushed south from the port of Darwin to Birdum, 316 miles, and northward from Adelaide to Alice Springs, 981 miles. However, a highway had been built for 313 miles north from Alice Springs, and the construction of the remaining link of 317 miles to Birdum was carried out by the state highway departments of South Australia, New South Wales and Queensland, each handling approximately one-third of the distance. Rapid progress was essential to complete the work in less than four months in order to avoid the rainy season. Men, machinery and materials had to be transported long distances by railroad and sea to reach construction sites and camps. Work was carried on in two or three eight-hour shifts, and traveling workshops provided for ordinary repair work. Much of the machinery was of American make.

Since designed for a daily traffic of 100 motor trucks of 3-ton capacity, traveling in convoys at 25 miles per hour, a standard width of 40 ft. was adopted (30 ft. in hilly sections), the central 16 ft. being paved with compacted gravel. Several streams, normally dry, were crossed by concrete fords or by paved shallow causeways. Of the latter, the longest, 5,800 ft., at Newcastle Creek, has a gravel fill about 3 ft. deep, banked with a sloped earthfill on the upstream side and a heavy rock revetment on the downstream side. On this base is a 6-in. course of stone blocks covered with a 2-in. wearing course of bitumen-penetration gravel, 16 ft. wide. The following description of the work is abstracted from an article in the *Railway Gazette* (London) of Nov. 28.

Owing to the extremely friable nature of most of the soil, which through the long dry season is fine dust a foot or more deep, it was decided that service roads on one or both sides of the final roadway were essential, so that construction vehicles would not damage the surface before the gravel surfacing was completed. In general, power graders (sometimes assisted by tractors with long tow ropes) handled the grading, after crawler-mounted bulldozers or angle-dozers had cleared the way. On the section built by the New South Wales forces, the roadbed was consolidated with sheepsfoot rollers. Gravel was stacked at convenient points by machines, and mechanical loaders filled the motor trucks which distributed it. In some cases, however, wheeled scrapers or bulldozers moved the material onto loading platforms having a central opening under which the trucks stood. Spreading of the gravel was done by road graders hauled by tractors.

Camps and supply depots were established at suitable points and commonwealth military authorities undertook the supply and transport of food. An army signaling section maintained communications throughout the work by wireless telephones and by tapping the transcontinental telegraph lines.

Studies of Steel Economy in Concrete Slabs and Columns

A. J. Boase
Manager, Structural Bureau
Portland Cement Association, Chicago

***Contents in Brief**—Comparison of the steel required in various types of concrete floor systems shows the flat slab to be the most economical. Columns designed according to the 1937 Chicago code or the 1938 New York code take less steel than if the A.C.I. 1941 code is used. If large loads have to be carried on small columns, steel may be saved by using high-strength concrete.*

THE PREMIUM that war conditions place on designs that use a minimum of steel has led to studies of the relative amounts of reinforcing required in different types of concrete slabs and in columns proportioned according to various building codes. The results may prove useful to designers of some of the structures in the war construction program.

The first study involved a comparison of concrete floor systems. Seven types of concrete floor systems were designed, including the supporting beams, the design being based on the American Concrete Institute code, 1936, with $f_s = 20{,}000$ psi. and $f'_c = 2{,}500$ psi.

The investigations included three live loads—50, 100, 150 lb. per sq.ft.—and three sizes of square panels—15, 20, 25 ft. The following steel quantities in lb. per sq.ft. of floor area are taken from these studies for 20-ft. spans and 100-lb. loading:

1. 20-in. metal pans	2.77
2. 30-in. metal pans	2.58
3. 12-in. masonry filler	3.54
4. 16-in. masonry filler	3.43
5. One-way slab	3.01
6. Two-way slab	3.70
7. Flat slab (girderless with two-way reinforcement)	2.13

The steel factor is seen to be smallest for the flat slab and largest in floors with masonry fillers and in the two-way slab. The floors with metal pans and the one-way slab are between the extremes.

Neither flat slab nor solid slab ceilings need metal lath or plaster. Constructions that require suspended ceilings with metal lath should have approximately one-half pound added to their steel factors. The metal pan floors, with suspended ceiling added, will require more steel than the one-way slab, which then becomes the second-best choice.

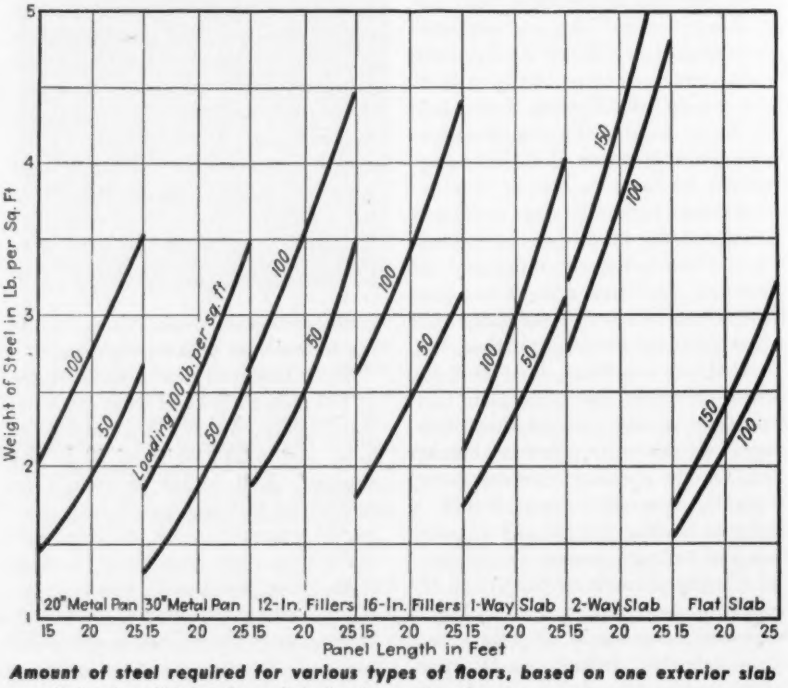
The steel factor for one-way slab may be reduced 20 percent by designing the slab steel for $f_s = 25{,}000$ psi. This stress is permitted by the 1941 edition of the A.C.I. code, if the yield point of the slab steel is at least 50,000 psi.

Weights of steel per sq.ft. taken from the studies are plotted in the accompanying chart. Increasing the load increases all the steel factors, but the smallest increase is in the flat slab, the superiority of which becomes more marked the greater the load to be supported.

A second set of studies related to reinforcement in columns. The steel requirements in columns proportioned according to various building codes may be illustrated by reference to a number of designs for which column sizes and steel weights are given in the accompanying table. The column load assumed is 500 kips, and the steel weights are given per column with 12-ft. story height. Various assumptions and design conditions are given in the table. Four design codes are included.

The following conclusions may be drawn from the values in the table:

(a) The A.C.I. code, 1936, is the most unfavorable of the four considered.
(b) The New York and Chicago codes



Amount of steel required for various types of floors, based on one exterior slab panel plus two-thirds of one interior beam. Panels are square.

WEIGHT OF REINFORCEMENT PER COLUMN IN LB. PER 12-FT. STORY HEIGHT

Col. load 500 k. A structural steel column of equal capacity would weigh 1,300 lb. per 12 ft. story height.	f'_c = 3000										f'_c = 5000						f'_c = 3750			
	1		2		3		4		5		6		7		8		9		10	
	Minimum steel				Same size as 2		Size reduced compared with 2, 3				Min. steel		Size reduced compared with 6				Size reduced			
	Tied		Spiral		Tied		Tied		Spiral		Tied		Tied		Spiral		Tied		Spiral	
	Col. size	Reinf. lb.	Col. size	Reinf. lb.	Col. size	Reinf. lb.	Col. size	Reinf. lb.	Col. size	Reinf. lb.	Col. size	Reinf. lb.	Col. size	Reinf. lb.	Col. size	Reinf. lb.	Col. size	Reinf. lb.	Col. size	Reinf. lb.
J. C. 1940.....	28	387	25	630	25	643	22	937	22	788	22	257	20	545	20	653	22	681	22	630
A. C. I. 1936....	30	444	25	630	25	944	....	....	22	812	22	574	....	....	20	677	22	984	22	658
N. Y. 1938†.....	26	174	25	448*	25	212	22	916	22	723	....	....	....	....	....	....	....	....	....	.....
Chi. 1937.....	26	347	25	517*	25	464	22	782	22	695	22	249	20	374	20	536	22	507	22	569

† f'_c = 3400 is max. allowed. * These values are close to min. steel.
Note: 24 dia. added for lapped splices. 15 lb. added for ties per column. 15 lb. added for spiral spacers. Hot rolled spirals assumed 11 ft. high. All columns are square.

require less steel than the Joint Committee code, 1940, which, incidentally, is the same as the A.C.I. 1941 code.

(c) By comparing item 4 and 6, it is seen that when loads are large and column sizes small, much steel may be saved by using high-strength concrete.

(d) Tied columns, in general, require less steel than spiral columns.

In addition, some miscellaneous comments may be made. Spirals may be stressed to 40,000 (int. grade), 50,000 (hard grade), or 60,000 (cold drawn). A saving can be made by changing to the harder grades.

Some codes, such as New York and Chicago, allow the use of a fairly large number of spirals for any one column size. In accordance with such codes, spiral columns use less steel when they are designed with a maximum amount of spiral.

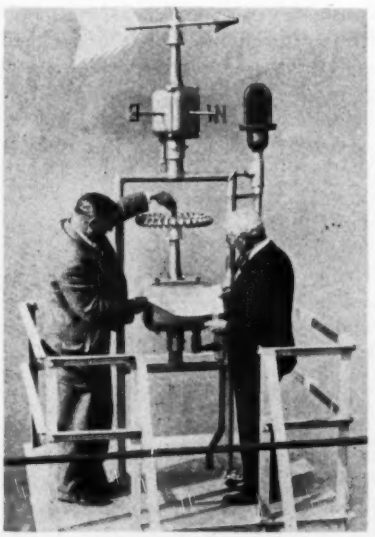
Laps used for splicing vertical bars consume much steel. In many instances, compressive stress could be transferred from bar to bar by means of butt-splices, the bars being aligned by metal sleeves, or the butt-splices may be welded.

Golden Gate Bridge Movements Being Reported for Study

INSTRUMENTS installed recently on the Golden Gate Bridge at San Francisco for accurate recording of movements that occur under wind loads include a wind velocity recorder, a wind directional recorder and a non-sensitive recording seismograph. Vertical and horizontal graduated boards at midspan will facilitate observations with a transit to measure movement in these two planes.

A series of white marker boards also has been fastened to the suspender cables at 150-ft. intervals, their bottoms in the same horizontal plane with a marker on the opposite shore to the observation point. The markers are for photographic records to be taken from a vantage point on the San Francisco side whence one picture will show the relative positions of all of the markers at once. Any slight vertical disalignment, such as was observed during the storm mentioned in *ENR*, Feb. 24, 1938, p. 311, would be apparent in such a photograph. Also, from such a picture, a study could be made of relative positions of the markers at different points along the bridge.

The temperature range that occurs at San Francisco causes expansion and contraction that produces vertical movement of the 4,200-ft. main span calculated at about 12 in. The bridge is designed for a maximum horizontal disalignment, under a 90-mile wind, of about 18 ft. It has been estimated, however, that the structure could withstand horizontal deflection as great as 27 ft.



Wind directional and velocity recording instruments installed on the Golden Gate Bridge.

The wind vane and anemometer are mounted on a structural steel platform on the west or ocean side of the bridge at midspan. Both these instruments are electrically connected to motor-driven recording units in the east leg of the south tower. At this point a 24-hr. continuous record is maintained from the two wind instruments and the seismograph. Only when special conditions obtain, considered worthy of record, will readings be made on the vertical and horizontal graduated boards and in the form of photographic records of the markers on the suspender cables of the bridge.

With these records it is expected that useful information will be obtained as to the various movements caused under different wind conditions; for example, as in the case of a 72-mph. wind such as was recorded during a storm in 1938.

William H. Harrelson is general manager of the Golden Gate Bridge and Highway District, L. H. Nishkian is engineer and S. J. Dickson maintenance superintendent.

Frequent safety meetings in the field kept the men awake to dangers.

Safe Jobs Save Time

A. W. Meinke
Assistant Secretary, Engineering Dept.
Indemnity Insurance Co. of North America
Philadelphia, Pa.

***Contents in Brief**—A contractor charged with building a transmission line through swampy, heavily wooded country reduced both the severity and frequency of accidents by following safety measures suggested and put into operation by an engineer of his casualty insurance company. Safer methods of storing and handling explosives, of using and carrying tools, of cutting and felling trees, of unloading and erecting poles reduced lost time from layoffs and slowdowns to such an extent that the job was materially speeded up.*

ACCIDENTS COST OUR COUNTRY $3,500,000,000 annually in wage loss, medical expense and property damage. Worst of all, when translated into today's conditions, they represent enough lost man-hours each year to build 45 battleships, 197,000 light tanks or 75,000 fighter planes. Construction's contribution to this total is particularly serious because every lost hour on construction postpones the time when production of these vital war machines can begin. How one construction contractor took advantage of means of safety education available as a byproduct of his casualty insurance is the theme of this article.

Transmission line work

It is the story of a 37-mile 33,000-volt 3-phase transmission line that had to be pushed through snake-infested and heavily-wooded swamps in the southeastern United States as part of a $2,000,000 project that also included power plant and railroad construction. And it is the story of the activities of S. J. Steinmann, supervisor of the engineering department of the Indemnity Insurance Company of North America, which insured the job, who went down there on the invitation of Marsh and McLennan, the insurance brokers, to aid the contractor in protecting the job from a safety standpoint.

When Steinmann arrived, he found one gang constructing the powerhouse, and a second clearing the 60-ft. wide, 37-mile long right-of-way. There was no time for laborers to lean on shovels, for the government wanted rapid completion. The men sweat and raised blisters on their hands as they swung their keen, brush-axes to hack their way foot by foot through a jungle of tangled underbrush. Frequently, the axes glanced off the tough and springy vines and bit into the legs of workers —leaving long, deep, bleeding gashes. Many of these men were negroes and, in spite of the sharp stubble where the brush had been cut, they were poorly shod or wore no shoes at all. There were numerous poisonous snakes in the underbrush, and on a similar job a few miles away several workers died of snake bites.

Felling large trees

Behind the brush clearers came the timber cutters who felled the large trees, many of them 4 ft. or more in diameter. Frequently these trees fell into clusters of other trees, which were standing within the right-of-way. Workers then had to climb the trees to cut the timber loose and drop it to the ground. It was evident that this dangerous method of freeing trees would have to be changed.

Large trees along the margins of the right-of-way, referred to as "danger timber," had to be cut down to eliminate the possibility of their being thrown on to the transmission lines during high winds. The felling of "danger timber" also presented a serious problem. Uusually the only space into which these trees could be dropped was the right-of-way itself, which would thus have to be cleared. It was frequently necessary, therefore, to cut down a number of smaller trees behind the larger ones which were then cut and pulled into the newly cleared space by means of block and tackle. This, however, was also a dangerous task.

Improper unloading of poles

In the meantime, another gang unloaded poles from flat cars and hauled them to points where they were to be set up in the ground to carry the power transmission lines. Although the foreman had been carefully instructed by the superintendent in the safe way to unload poles from flat cars, the leader of the gang worked out a shortcut to speed up this work, which had serious consequences. The poles were held in place on the car by side stakes and three bands of strap steel. The stakes on opposite sides of the car were also wired together in pairs, the wires passing over the load of poles. In the "shortcut method", two men cut the bands on one side of the flat car with axes, and then climbed to the top of the load to cut the crosswires between the stakes. When the wires were cut, the stakes, contrary to expectations, failed to hold the load and broke,

letting the poles tumble to the ground in an avalanche on both sides of the car. Obviously, this "shortcut method" was dangerous and its use had to be prohibited.

After being unloaded, the poles were dragged by mules to the points where they were to be set. In the firm ground, the workers were able to dig holes by hand, and after a gang of workers had raised the pole to an unright position with pike poles, the dirt was filled in around the foot of the pole in the usual manner. In the swamps, however, the problem was much more complex. Mules could not be used for dragging poles because they sank to their bellies in soft mud. This presented a problem which was overcome by using brush and tree trunks to make corduroy roads over which gangs of workmen dragged the poles to points of erection.

Poles set with dynamite

It was impossible to dig deep holes in the soft swamp, as the mud and quicksand flowed back into the hole every time a shovelful was removed. It was necessary, therefore, to blast holes in the mud with dynamite. The first step in setting poles with dynamite was to raise the pole into a vertical position with pikes and hold it there. Then a pipe, about 9 ft. long, was pushed or driven vertically into the mud close to the foot of the pole. After ramming the mud out of the pipe, a half stick of dynamite, attached to the ends of the electric wire used in discharging the explosive, was lowered into the ground through the pipe. Then mud was tamped on top of the dynamite and the pipe was withdrawn, leaving the dynamite and wires deep in the mud below the pole. When the dynamite was discharged, the blast momentarily opened a hole into which the bottom of the pole fell immediately. There was no need to fill in around the pole because the soft mud ran back into place like thick molasses and grasped the pole with sticky fingers. When the hole had closed, the pikes used in supporting the pole during setting operations could be removed.

Frequently the setting of poles with dynamite was seriously complicated by enormous roots of trees buried in the mud. In such cases, the roots had to be blasted before anything else could be done. Sometimes as many as seven sticks of dynamite had to be discharged to blast the roots out of one hole. In some spots there were deep quicksand beds, and to prevent the poles being drawn too far down into the muck, braced platforms, or "bog shoes", were attached to the poles at ground level.

Although the contractors had had an excellent safety record for many years, this job presented an unusual accident problem not only because of the numerous hazards but also because of the excessive labor turnover. The workers quit because they did not relish blistered hands and aching backs. Many could not stand the heavy work in the extreme and humid heat. Some quit because they feared the venomous snakes. Others were placed on the inactive list by injuries. Naturally, the contractors welcomed the assistance of the indemnity safety engineer who could devote his entire time to the safety problem.

Upon Steinmann's recommendation, separate underground magazines for storing dynamite and detonators were constructed in the woods at a safe distance from operations. These magazines were provided with prominent "Danger" signs.

The body of the truck used for hauling explosives was rebuilt to shield metal parts, and a "Danger" sign was posted conspicuously on it. Men were fed salt tablets to prevent heat exhaustion.

Swamps, snakes and heavy timber created hazards on a transmission line job that had to be overcome if speedy completion was to be obtained.

Making the men wear substantial shoes or boots cut down accidents on such operations as dragging the transmission line poles to point of erection.

Choke cables were used in controlling and retarding the movement of the poles as they were released from the flat cars. These choke cables could be operated from a distance, where men were out of danger from falling poles.

First-aid facilities were provided for snake bites, blistered hands and creosote burns, and competent men were trained in administering first aid.

Brush cutters were not permitted to work so closely together as to be in danger of being struck by a fellow-worker's brush axe. The men were instructed to keep a tight grip with both hands on axe-handles so the axes would not rebound when they struck the wiry vines growing on the trees; and the men were cautioned not to carry double-edged brush axes over their shoulders but to carry them in one hand, away from the body, and in such a manner that the blades would fall flat on the ground if the person carrying the axe stumbled while walking over the rough ground.

All safety belts, used by men who climbed trees and poles, were examined and tested, and many defective belts were replaced. All employees were required to wear shoes.

Tree hooks were provided for men who had to climb trees to attach lines used in pulling danger timber away from the right-of-way.

The use of pikes to hold the poles while they were being set with dynamite was discontinued and guy lines were substituted, a procedure that definitely prevented two serious accidents when the tops of two poles flew off as the charge was fired and fell where the pike men would have been standing.

Finally, meetings were held at various points along the job to explain to new men the safe way to do the task at hand, and the contractor appointed one of his best men to be trained by Mr. Steinmann in controlling the unusual accident hazards.

This project is now on its way to completion, marked by a substantial decrease in accident frequency and severity from the time when the insurance company's safety engineer stepped into the picture. The results amply repaid Mr. Steinmann for his long hours and hard work, and demonstrated how the casualty safety engineer can do a great deal to increase the speed of jobs that are vital to a successful outcome of the war.

Patent Rights Waived on Wood Sash To Speed War-Plant Construction

To MEET the restrictions on use of steel in building, a new type of wood sash has been developed by a member of the firm of Albert Kahn Associated Architects & Engineers, Inc., of Detroit, which can be used in place of standard steel sash for industrial buildings. To make the new sash available to all designers of war-production plants, John Schurman, its designer, and the Albert Kahn organization of which he long has been a member, have waived all patent rights. Detail prints are available to the entire war-production building industry, Albert Kahn, head of the firm, announces.

In creating the new sash, full advantage was taken of experience gained in the development of steel sash, with its simple frame and mullion construction and its simple, compact ventilators, all built at the factory in standard units.

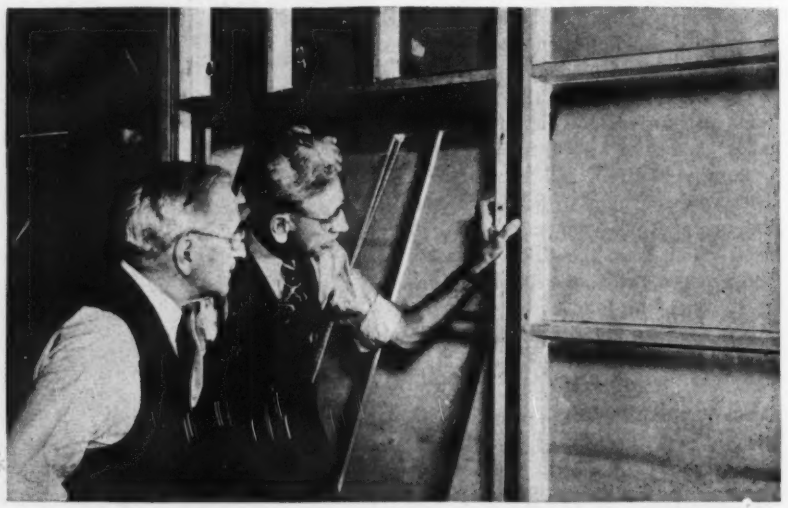
Since most industrial buildings have 20-ft. column centers in the outside walls, a 4-ft. width was adopted for the units of the new window. Vertical heights vary up to 12 ft. 6¼ in., with provision being made in the design for repetition above a simple girt of structural steel. Each unit has two side mullions, 2⅝ in. thick by 2⅛ in. wide, and may be divided by muntins into horizontal sections for 20-in. panes (as shown at the right in the accompanying photograph), or by both horizontal and vertical muntins to accommodate 14x40-in. glass.

Each unit is built complete in the mill and shipped to the job where it is erected between head and sill; no other frame is required. The wood sash is erected in the field the same as steel sash. As the units are erected, the mullions are joined by a channel-shaped coverplate of light pressed metal, the legs of which are pressed into caulking compound in vertical chases in the mullions. Bolts from the front to back coverplate pass through a ¼-in. space between the section. (One of the coverplates is shown in the photograph.)

Glazing is done on the inside, rather than the outside, so that the weaker part of the wood section and the putty are protected from the weather. The glass is secured on the inside by means of standard spring glazing clips such as are used in steel sash.

The ventilator of the new sash is similar to that of steel sash which, through years of development, has reached a high degree of perfection.

While the new sash was developed primarily as a substitute for steel sash, it is expected to have many logical uses after the war. For example, it would serve well where severe acid conditions prevail, and wood withstands better than steel the effects of salt air.



Albert Kahn (left) and John Schurman examine the new type wood sash, in which sections are welded together by a small metal strip.

Wartime priorities make care in maintenance and operation a first consideration for all construction equipment.

Making Equipment Last Longer

***Contents in Brief**—Construction equipment is becoming increasingly hard to get even with high priorities. Therefore the contractor and owner will be wise in keeping the units now on hand in good running order and to use care in maintenance and operation to prolong the equipment life as much as possible. Allis-Chalmers Mfg. Co. offers some excellent advice in regard to tractors, scrapers and graders, which is passed on in the following article.*

"KEEP 'EM ROLLING" applies to construction equipment as well as to combat units. Because the machines of construction are getting scarce, contractors and construction agencies must make the units on hand operate most efficiently and last as long as possible.

To accomplish these aims a new attitude toward use of equipment is necessary. Heretofore, from an economic standpoint, it was generally cheaper to work equipment hard, and depreciate it up to 100 percent on one big job. Such is not the case today. Equipment must be used, of course, and used fast and to capacity. Yet it must be used judiciously to prolong its life. Allis-Chalmers Manufacturing Co. has issued an excellent set of suggestions as to proper use, care and operation of tractors, scrapers and road graders for longer life and better performance. Many of the following suggestions are taken from the A-C house organ, *The Reporter*, for Feb.-March, 1942.

First of all, it will be well to call one or more meetings of all employees who have even a remote connection with equipment—everyone from the purchasing agent down through the superintendents, engineers, foremen, mechanics, grease monkeys and operators. Explain to them the vital necessity of an equipment conservation program, how it affects each of them, the job they are on and the nation, the part the construction home front plays in backing up the boys at the battle front, how every machine they keep rolling permits the maker to deliver one more to Uncle Sam.

Equipment conservation starts with job planning. Of course every job today must be done fast—faster than the last one—but intelligent planning will develop a program that will reduce equipment travel to the minimum, will plan the job so as not to overwork the equipment, and will get the utmost efficiency out of every machine. Overloading is the greatest enemy of equipment, and must be avoided in these times. Once the working procedure is established, place the equipment under the control of a competent supervisor, high enough in the organization to have complete authority over the maintenance and operation of all machines. A separate record should be kept for each unit, showing its origin, make, size, model, capacity, auxiliary equipment, major repairs, and service.

Next, set up proper shop and field facilities for repair and servicing. Wartime shops should include high-capacity electric welders, lathes and grinders for building up worn parts. Such facilities will save many operating hours in these times of scarce materials and delayed parts orders.

Oiling, greasing and refueling may be done either in the field from portable service units or at central stations. It is best to designate a specific time for servicing each machine or groups of machines, when a competent mechanic can give them a quick inspection, checking the tires, clutches, brakes, oil filters, batteries, etc. Minor repairs and adjustments should be made at once, and major repairs should not be put off to invite a complete breakdown. Records of all services will aid in averting trouble, first, because requiring such records will help prevent slip-ups in

servicing, and second, examination of continuous records of any machine will aid in spotting trouble before it gets serious.

Too much emphasis cannot be placed on the importance of proper lubrication. Manufacturers issue lubrication instruction for each machine, with recommendations for proper grades of lubricants, and they will be glad to furnish such sheets for any model machine should the originals become misplaced. Performance must be considered in the lubrication schedule. "Grease once a day," for example, has a different meaning on one-shift and on three-shift operations. And keep oils, greases and fuels clean and free from water. Much damage has been done by dirt in lubricants, and by water in diesel fuel oil; water sets up a corrosive action in diesel engine cylinders.

Again, the equipment supervisor should warn against overloading. Construction machines are tough, they will take a lot of punishment, but there is a limit to which even machines can be pushed. The last half-yard of dirt in a scraper may not be worth the strain of loading.

Operator's job

The management must train and educate the operating personnel properly to use and save the equipment, for poor operators will nullify the best-laid plans for conservation. It is not enough that the operator knows how to run the machine, he must know how to take care of it, to know when minor adjustments are necessary and be able to make them. He must know how to use his machine without abusing it, and be able to recognize faulty performance that indicates serious trouble. Instructions to operators might well include the following details:

In operating a tractor it is important to maintain the "feel" of the load at all times to prevent overloading. Spinning the tracks, cracking the steering clutches to snake the tractor along, releasing the clutch to gain engine speed and then jamming the clutch in under full load are practices not to be tolerated. It is much better to ease up on the load and save the machine. Travel on crowned roads should be in the center, if possible, to equalize wear on the tracks, and travel on hard-surfaced roads should be avoided. When pulling a grader, offset the tongue or use a cable hitch so the tractor rides out of the ditch on better footing. Short turns at high speed are spectacular, but are hard on the tracks and steering clutches, as also are wide sweeping turns with one clutch disengaged. Too much turning in one direction is also hard on the steering clutches, and turns should be made alternately to the left and right whenever possible.

Idling a tractor engine, either gas or diesel, especially at low speed, is extremely injurious, causing crank case dilution, carbon deposits, sticking rings, etc. In addition it is very wasteful of fuel. Shut the engine off whenever possible. If it is necessary to let the engine idle a few minutes, the transmission should be shifted to neutral and the master clutch engaged. This saves wear on the pilot bearings and prolongs clutch life.

Equipment distributors are in a position to help you "Keep 'Em Rolling". No matter where you are working or what make of equipment you are using, there is probably a distributor nearby who has a service and parts department available to you day and night. Let the equipment distributor help you get the most from your equipment.

In cold weather do not crank the engine too long with the battery. A heavy-duty electric starter can crank an engine continuously for 30 sec., then it should be allowed to rest for 15 min. to prevent damage from overheating. Before using the starter check the engine to see that it is ready for starting. Allow the motor to run about one-third throttle until it runs evenly, then open the throttle until proper engine temperature has been reached. Operators should use radiator shutters when necessary to maintain engine temperature.

Proper track tension, accurately adjusted guards and wear-takeup adjustments are all important, and these items should be inspected and attended to at regular short intervals, especially on older equipment. Tractor clutches, both master and steering, are made to operate only in either of two positions; engaged or disengaged. When the operator only partly engages a clutch he is subjecting it to excessive wear.

In scraper operation it is most important to keep the tires properly inflated—improper inflation causes the same destructive wear on scraper tires as it does on automobile tires. Frequently dirt clogs up and dries between tires and the bowl, and the resultant rubbing action is hard on the tires. It is important to keep tires and adjacent areas clean.

The operator should report worn cutting edges for it is cheaper to replace a cutting edge than to build up a bowl. In operating a scraper the bowl should not be dropped and caught with the winch or hydraulic system just before it reaches bottom, for such practice causes excessive cable wear and subjects the winch or hydraulic system to severe and possibly injurious shock. The winch should be kept well greased and properly adjusted to reduce cable wear. In loading rock it is important to avoid shock, which damages both tires and operating mechanism.

The same general instructions apply to road graders as to tractors and scrapers. Tires should be kept properly inflated, and clutches and brakes must be inspected frequently and operated with care. Most parts on a grader subject to wear are provided with takeup adjustments, which must be checked frequently.

Power graders easily can be overloaded, and if the engine slows down or the wheels begin to spin the operator should ease up on the blade, take a smaller bite or adjust the blade angle slightly to decrease the load.

The drive wheels must be kept tight on the axle, for a loose wheel will quickly damage bearings, injure brakes and increase tire wear. Cutting edges must be replaced or reversed before they wear through to the moldboard. If the grader is equipped with leaning front wheels the operator should adjust them as required to prevent dragging the front tires against the bank.

These suggestions are, of course, only general to indicate the type of cooperation desired from operating and maintenance personnel. The most important thing to remember is for all to cooperate in starting such a program. Its success depends upon full cooperation among operators, oilers and mechanics to the point where one will inform the others when the machine needs attention.

How to Save Oxyacetylene

KEEPING war industries supplied with oxyacetylene for welding and cutting is no less essential than providing the metals for production. The demand for these gases has increased enormously. Due to shortage of cylinders for transporting gases and to a limited capacity for oxygen production the industry is being strained to the utmost to supply the pyramiding oxygen requirements.

A number of wasteful practices that might be overlooked in peacetime, but today should not be tolerated, are revealed in a study made by the Air Reduction Sales Co. Such waste, seemingly trivial in individual instances, actually amounts to a staggering total. For example, one shop investigated was found to be wasting unknowingly about 25 percent of its oxygen consumption through an accumulation of "insignificant" losses. The study points out that elimination of wasteful practices will go a long way toward relieving a scarcity of oxygen, will assure an uninterrupted supply of gases, and will prove economical to the individual job.

Following is a list of recommended "Do's and Don't" compiled by the Air Reduction Sales Co., from observations of correctible conditions in oxyacetylene use.

Concerning tips and burning

Use proper torch tips—A No. 2 torch tip used instead of the No. 1 for cutting ½-in. plates consumes 10 to 20 percent more oxygen and 16 percent more acetylene—all waste.

Keep tips clean—An unclean tip is an inefficient tip. Congested orifices not only nullify the value of using proper pressures and speeds, but also result in lowered efficiency and consequent waste of gas. Use a cleaning drill frequently.

Avoid excessive pressures—Pressures recommended on the manufacturer's chart are the most efficient for average conditions. Refer often to the chart to make sure you get the best from your equipment. When more speed is necessary the new high-speed machine cutting tips cut faster without additional oxygen.

Close cylinder valves—If only the torch valve is closed, gas pressure in the hose rises during the time the torch is not used and may force leaks.

Stop flame when not cutting—If a torch burns idly for even as little as 3 min. out of each hour it is wasting 5 percent of its gas consumption. Last year's wastage from this source would have amounted to 1,636,000 tankfuls.

Hints on hose

Handle with care—Hose is made of rubber and must be protected to insure full life. Keep the hose out of range of hot oxide and sparks; wash off oil and grease as they are ruinous to rubber; protect the hose where it crosses truck runways; store all reserve stocks in a cool, dark place, and when a hose is damaged, cut out the damaged portion and splice the ends together with standard splicing nipples.

Use short lengths—Unnecessarily long lengths of hose call for higher pressures to overcome losses due to friction. Furthermore, the surplus length is subjected to unnecessary wear and tear.

Use correct diameter—Hose that is too small for the job requires higher gage pressure to insure sufficient flow causing uncalled for strain and inducing leakage losses.

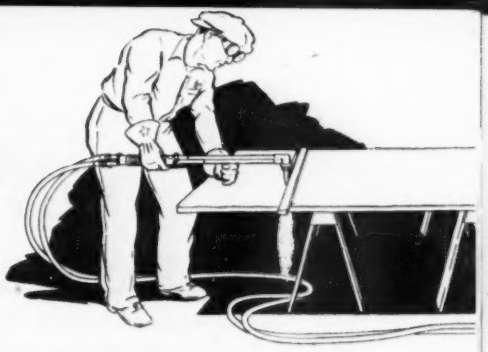
Check for leaks—Leaks may seem infinitesimal, but a $\frac{1}{64}$-in. dia. leak in hose operating 100 psi. will waste 290 cu. ft. of oxygen—more than a tank full in 24 hrs. Periodically the hose should be searched for leaks by submerging in water while under pressure. Soap and water will reveal leaks at connections.

Keep cylinders moving

Use all of each cylinder—Before changing to a new cylinder make certain that all the gas has been used. On larger work the interruptions caused by changing tanks can be eliminated by manifolding gas cylinders or by installing pipelines to a common supply.

Keep inventories low—Gas suppliers are cooperating by providing frequent deliveries of needed materials to speed the turnover of equipment. You can help by ordering fewer cylinders more frequently and by keeping reserve cylinders at a minimum.

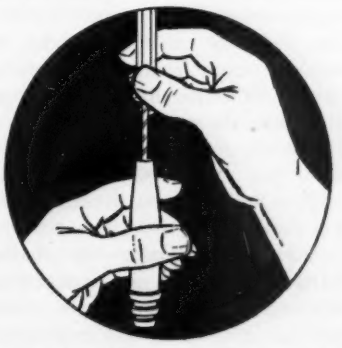
Make prompt return—Idle cylinders are production "slackers." Do not let them accumulate on your job.



Preserve your hose by keeping it clear of sparks and slag. Avoid fire hazards.

Don't leave torches burning when not in actual use. Oxygen is precious now.

Long hose requires more pressure and invites damage leading to leaks.



Keep your tips clean. Congested tips are inefficient, waste time and gas.

War Construction Projects From a Contractor's Viewpoint

NEARLY EVERY CONTRACTOR, architect-engineer and army officer upon completion of a large war construction project says, "If I had another job like this to build, I'd do it differently." Because of the fast construction tempo and the gigantic size of war jobs, some of which cover thousands of acres and cost millions of dollars, mistakes and exasperating delays are bound to occur.

If hindsight could replace foresight, the war construction task would be eased. And with that thought, a contractor's project manager on a big ordnance plant, offers some counsel for use as foresight by others connected with war construction projects.

Temporary Roads—The need for establishing a temporary road system as quickly as possible on the project cannot be overemphasized. To permit permanent road layout, design and other factors to delay the immediate installation of temporary roads to the various areas and buildings is a mistake that can delay a project from sixty to ninety days. Likewise, the construction of railroad sidings, spurs and storage track facilities should be started immediately; future needs of plant operations, not as yet determined, should not be allowed to delay this extremely important phase of transportation.

Basic Materials—Another factor that governs progress is the purchase of basic construction materials at the earliest dates possible. First, it is necessary that the architect-engineer organization develop their design to use the most easily procurable materials. Second, quantity surveys should be prepared immediately and the materials purchased for early delivery. Specifications should be flexible, and should be adjusted from time to time to meet prevailing market conditions.

Finished Hardware — A standard hardware schedule and specification draft should be decided upon at once and this material bought immediately. Elimination of complicated locking devices, panic bolts and other types of hardware requiring precise details and excessive machine shop work should be insisted upon. The idiosyncrasies of some specification writer or uninformed operator employee will seriously delay the completion of work.

Materials Handling—One of the serious bottlenecks on some projects has been the method of receiving and checking material by the government organization. (The contractor buys and pays for materials; the government receives and stores them, issues them out on job requisitions.) It is suggested that this phase of the work should be handled by the constructor, inasmuch as:

(a) It has been ruled that the responsibility of errors by the government forces is the responsibility of the constructor;
(b) The constructor has or can procure an organization thoroughly trained in the handling of construction material in large volume.

In other words, this work should be supervised by the proper government agency but not performed by it.

Organization—It is recommended also that the architectural, engineering and mechanical design should be under one chief engineer. A lack of coordination between mechanical departments and construction engineering introduces problems in the field that cause considerable delay and expense. A council is not conducive to fast construction.

Shop Facilities—The advantage of having a properly equipped sheet metal shop and a forge and machine shop deserves careful consideration. A great deal of time has been saved on one project by making the sheet metal flashings, expansion joints, and miscellaneous sheet metal items right on the job. This procedure was developed through sheer necessity on this particular project but the results were so gratifying that plans have been made to establish these facilities on a more complete scale on future projects.

Equipment and Repairs—A plan providing for manufacturers of tractors, crawlers, and automotive equipment of all kinds, to set up well-assorted stocks of various parts on consignment should be followed. Storage and stockroom space should be provided and, under the supervision of proper government agency, the various items checked out upon requisition. The billing of all of these items would be based solely on properly approved requisition, and all unrequisitioned stock would remain the property and liability of the various manufacturers. This plan affords:

(a) Immediate delivery of critical items in nearly all cases, eliminating the shut-down of expensive equipment;

(b) Lower investment in unused or unrequisitioned materials; on large projects this is a very considerable item.

Water Charge Survey

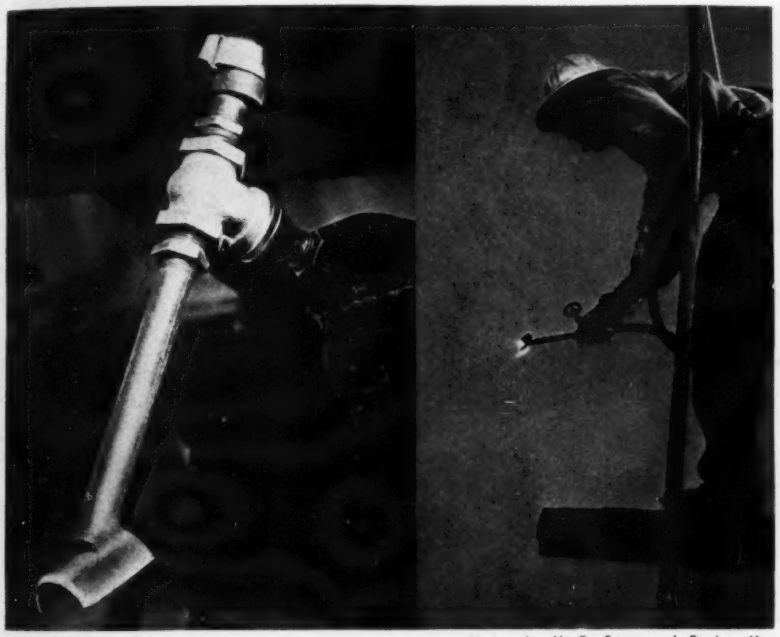
The average resident of a city of over 300,000 population pays 97c. a month for 5,000 gallons of water, according to a survey of water charges in the 30 largest United States cities made by Barcus, Kindred & Co., Chicago, specialists in municipal bonds. Median charges for 3,000 and 10,000 gal. are 67c. and $1.88.

Highest water charges for both household and commercial use are paid by San Francisco, the survey shows. Lowest are paid by Chicago. San Francisco residents are charged $1.74 monthly for 3,000 gal., $2.43 for 5,000 and $4.16 for 10,000 gal. Chicagoans pay a net domestic rate of 71c. regardless of quantity.

In charges for industrial quantities, ranging from 15,000 to 1,000,000 gal. monthly, San Francisco ranks highest. Chicago is lowest. For 5,000,000 gallons—the largest industrial consumption studied—San Francisco levies $996 monthly, or the second highest charges among the 30 cities. New York is first with $1,002. Columbus, Ohio, is third, followed by Oakland, Cal., and Boston. New Orleans is lowest with charges of $330, immediately preceded by Houston, Texas, and Chicago. Median charges for all cities are $501.91.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS



Photos by U. S. Bureau of Reclamation

JOB-MADE NOZZLE AIDS IN SANDBLASTING

Surface of the steel drum gates on Grand Coulee Dam has been cleaned off by a sandblast, for which nozzles of several types were tried. Nozzles were varied by shaping a piece of standard pipe to experiment with effective coverage.

As developed on this job, the preferred nozzle, shown at left, consists of a short length of ½-in. pipe on whose end is welded a semi-cylindrical spreader. The spreader is half of a 1-in. coupling, split lengthwise and attached to the ½-in. pipe at an angle of about 60 deg. When held a few inches from the surface to be cleaned, as illustrated at the right, the resultant spread of sand gave the desired coverage. Under the attrition of the sand grains impelled by air pressure, the metal wore so rapidly that parts exposed to wear had to be case hardened.

Cross-Sectioning Clogged Drainage Ditches

A quick method of cross-sectioning drainage ditches that are to be cleaned is indicated by the accompanying sketches. This method has been used by the writer in Van Wert County, Ohio, while preparing plans for cleaning drainage ditches, of which the county has a large number. The law provides that, beginning at the ditch head, the ditch be measured and marked every 100 ft. with station stakes, and that levels be taken at all stations. Ditch cross-sections are taken at stations. The short cut described greatly reduces the amount of calculation required by the usual method of taking readings from the height of instrument to calculate the ditch depths.

The apparatus for cross-sectioning consists of a hand level, a leveling rod and a steel tape as shown by Fig. 1. Using an old Philadelphia rod the front section is removed, the ends reversed and the section replaced so that the zero can be set at the line of sight of the observer and clamped there. This gives a rod that can be read up to 6½ ft., which is sufficient for most of the county ditches. To save time and an extra man, a pin was made of ¼ or $\frac{5}{16}$-in. iron (steel would be better) about 18 to 20 in. long with a loop at the top for a handle, and a small hook at the handle to hold the metal tape used to measure the ditch widths. A metal holder is fashioned to clamp around the tape case and fasten the spool of tape to the rod so that the rodman can shift the rod across the ditch and, at the same time, observe the rod's distance from the station peg.

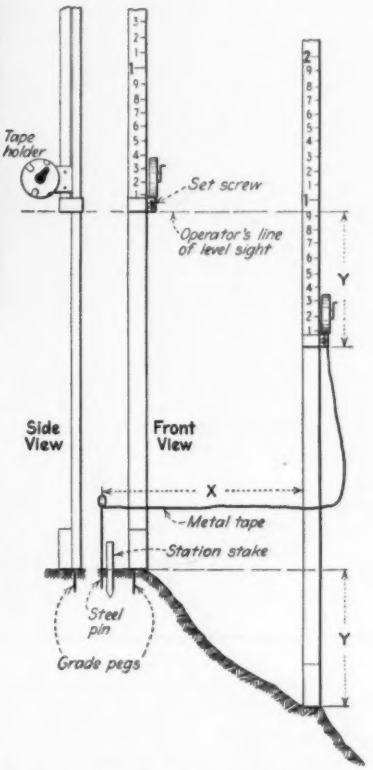


Fig. 1. Apparatus for rapid cross-sectioning of clogged ditches.

After the station stakes are set (usually on the left of the bank) and the levels run, the levelman—using a hand level—and the rodman—using the rod and tape—take the cross-section as follows: The rodman pins the tape with its zero at the station stake and, at the same time, the levelman adjusts the level rod by setting it on the grade peg at the station and raising the rod so that zero is on his line of sight. The rodman then carries the rod across

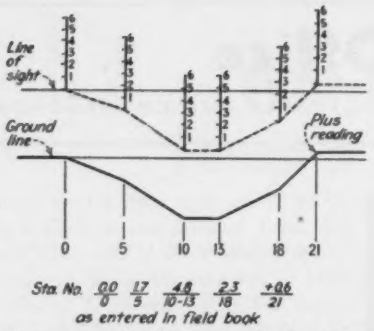
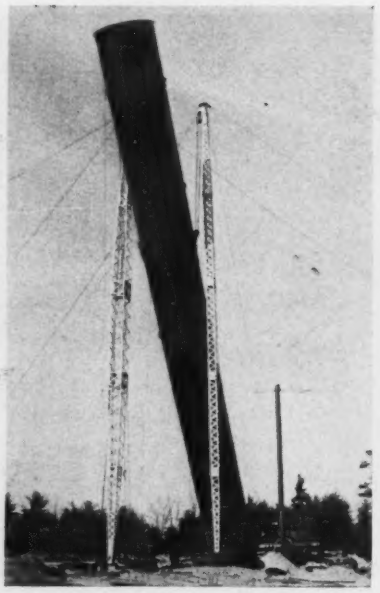


Fig. 2. Method of recording cross-section surveys.

the ditch to the first break in the grade; since the reading is for an average of the station, it is taken at the nearest foot for clearness in notes and plotting. The levelman reads to the nearest tenth. In this manner the various breaks across the ditch are noted; should the last be found to be above the line of sight, the height can usually be estimated or the rodman can measure it; on the notebook it is entered as a plus (Fig 2) so that the draftsman will be able to determine the location on the section. The sections are plotted on standard 10x10 cross-section paper, the heavy line being used as the elevation of the station; the scale used is two spaces per foot, that is 1 in. = 5 ft. From the level book the depth of the new cut is found and the new section plotted; from that the area is secured by the planimeter, it being a small matter to determine the setting so as to secure a direct reading.—J. F. MOLLENKOPF, *Van Wert, Ohio.*



CAMERA MEMORANDUM

The mast and the boom of a guy derrick are both used as gin poles for the erection of a 100-ft. steel stack. The stack was laid over the foundation and lifted by a 6-part line and cable bridle until sufficiently above the ground to swing into its final position.

Notes From War Jobs

METHODS USED TO SPEED CONSTRUCTION AND WIN THE WAR

Construction Ramp—In building a three-story, reinforced-concrete air depot building a contractor has connected the second story and the ground with a wide timber-framed ramp. Reinforcing steel and other supplies are carried up the ramp, leaving the materials hoist free to handle concrete. The foreman and workmen find that use of the ramp is quicker and safer than ladders for ordinary job traffic. The ramp, which parallels the long side of the building, is on about a 25-deg. incline and is fitted with cleats and with a railing along the outer edge.

Pre-attached Nailing Strips—The use of timber decks on steel roof trusses requires that a nailing strip be used on the top chords. By bolting the strips to the trusses while they are still on the ground, a contractor on an air corps supply building has increased both the speed and safety of roof construction on his job.

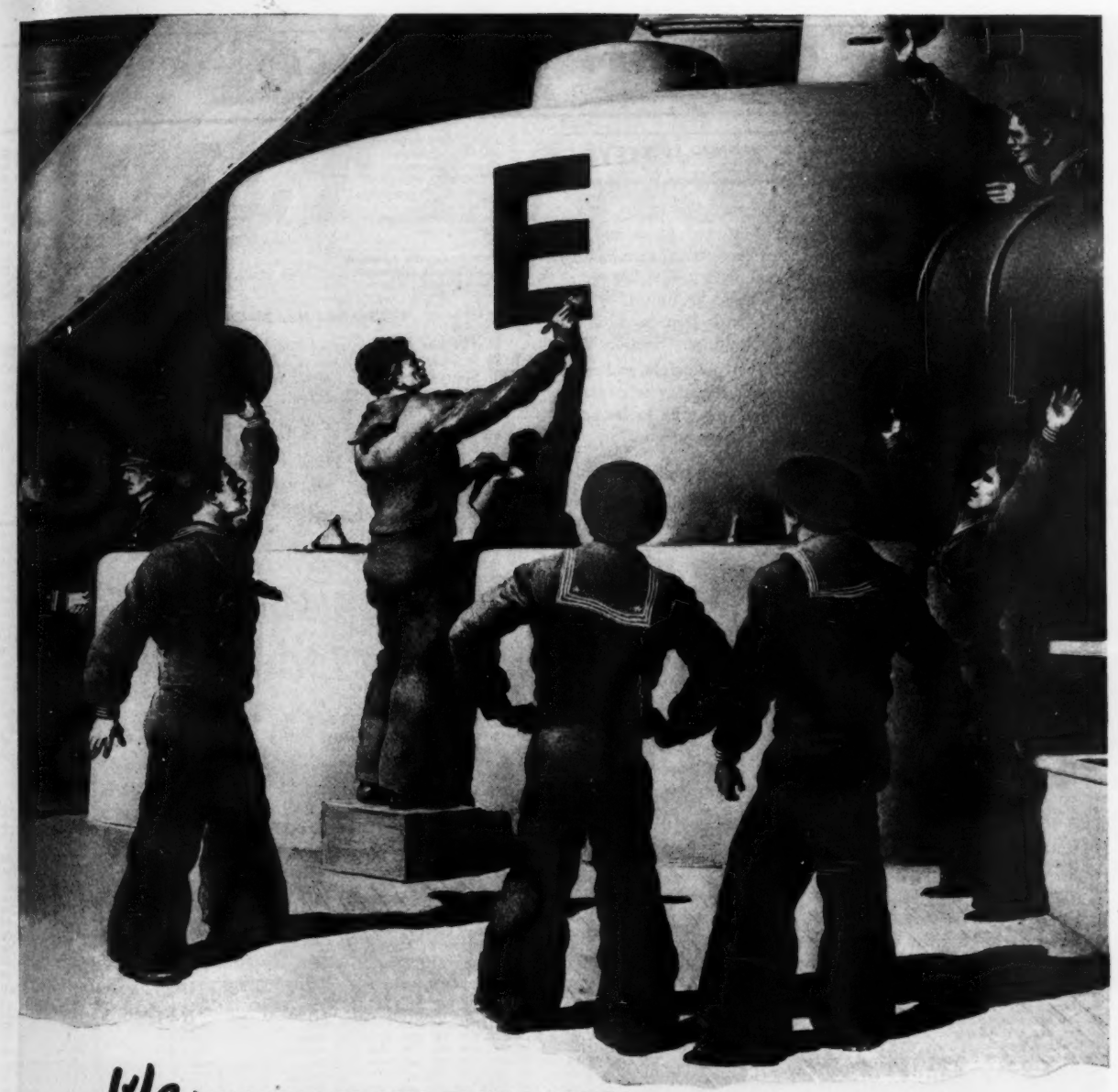
Well Points in Glacial Drift—Successful use of well points to lower groundwater in a glacial soil containing clay strata was a feature of the foundation work on a recent airplane engine test building. Rugged points without too fine a screen were required to stand the driving through boulders and gravel. The thinner clay layers were penetrated, but when a thick layer was encountered the points were stopped, and the water below this level drained to sumps. Simultaneous pumping from the sumps and from the well points dried the ground enough that excavation could proceed to 12 ft. below the surface.

Hot Air in Place of Salamanders—Extensive use of portable, oil-fired, hot-air furnaces in place of coke-burning salamanders eliminated the hazard of scaffold, form and tarpaulin fires on a winter airbase job. The furnaces, with four-directional hot air discharges, were mounted on skids and moved by tractors. A small gas engine operated the generating plant placed on the skids and provided power to run the blowers. The furnaces were used only on ground floors.

Central Mixed Mortar—Taking his cue from the widely used concrete central mix plant, a contractor on a large military establishment requiring extensive brick masonry established a central mixing plant for his mortar. By eliminating the necessity for getting sand, cement and water to a dozen different locations, it saved both time and money. The mortar could be hauled from the plant to the job in ordinary dump or agitator trucks.

Safety Nets on Hangars—Following their initial installation on the Golden Gate Bridge, rope safety nets have been used to protect the workmen on a number of bridge jobs. What is believed to be the first use on buildings is now taking place on some large army hangars with arched roofs rising 90 ft. above the ground. The nets, of ⅜-in. rope in 6-in. square mesh, are installed in units 25 ft. square. Their value is principally to the metal roofers and other mechanics who follow the steel erectors.

Practice Forming—Concrete stacks for airplane engine test cells require intricate forms, somewhat resembling those required for the draft tubes at hydro plants. To train his workmen to build these forms, one contractor had his men set up the first one on the ground adjacent to the carpenter shop. The work was done in odd moments while the foundations of the building were still underway and the carpenters, while not particularly busy, still had to be on the job to watch forms and take care of scaffolding and ramps in connection with the concreting activities.



We KNOW HOW THEY FELT!

Those men who earned the first Navy E, back in 1906, must have been the proudest crew of tars in the fleet. We know, for we feel the same bursting pride today. The blue Navy burgee now flying from our flagstaff sends a special thrill through every man in our plant. We're proud to be Americans.

The Navy E is not lightly given, nor lightly received. It means more than Excellence. It stands for a good job well done, for teamwork better than the best . . . and its award to any civilian plant should double and redouble fighting spirit. From now until final Victory dawns, we pledge every effort to help *Keep America Rolling.*

Exide
IRONCLAD
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

The World's Largest Manufacturers of Storage Batteries for Every Purpose

Exide Batteries of Canada, Limited, Toronto

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

SEWERAGE SYSTEM, NEW JERSEY

OWNER: City of Long Branch, N. J.

PROJECT: Construction of sewage treatment plant and appurtenances (Section I); outfall sewer with approximately 2,745 ft. of 30-in. reinforced concrete pipe and 1,200 ft. of 16-in. wrought iron pipe in ocean outlet (Section II); and 44,240 ft. of interceptor sewer ranging from 8-in. to 30-in. of both reinforced concrete and vitrified clay pipe (Section III).

CONDITIONS: Contractor to furnish all materials and complete work in 250 calendar days. Rail and highway transportation facilities available. Wages prevailing in area to be paid. Outfall sewer pipe laid on sand to permit movement.

Section No. 1—Sewage Treatment Plant

LIST OF BIDDERS: (Bids opened Jan. 19, 1942.)

1. Thomas Proctor Co., Long Branch, N. J. (contract) $200,457
2. Sutter Constr. Co., New York, N. Y. 298,445

Item	Quan.	Unit Prices (1)	(2)
1. Excavation, unclassified	7,000 c. y.	$4.00	$1.00
2. Rock excavation	100 c. y.	5.00	10.00
3. Timber and lumber	30 M bm.	50.00	100.00
4. Treated lumber	25 M bm.	200.00	200.00
5. Steel sheet piling	10 ton	65.00	100.00
6. Wood piles	20,000 l. f.	.60	1.00
7. Wood piles, creosoted	2,000 l. f.	1.00	1.85
8. Pile anchors	2,500 lb.	.15	.16
9. Underdrains, 4 to 6-in	600 l. f.	.60	.35
10. Crushed stone	500 c. y.	4.00	3.60
11. 5-in. terra cotta pipe	50 l. f.	1.20	.80
12. 6-in. terra cotta pipe	300 l. f.	1.30	.80
13. 8-in. terra cotta pipe	24 l. f.	2.00	1.00
14. 12-in. terra cotta pipe	24 l. f.	2.25	1.50
15. 12-in. rein. concrete pipe	40 l. f.	2.50	2.00
16. 15-in. rein. concrete pipe	156 l. f.	3.00	3.00
17. 18-in. rein. concrete pipe	115 l. f.	4.00	4.00
18. 24-in. rein. concrete pipe	30 l. f.	7.00	5.00
19. 30-in. rein. concrete pipe	172 l. f.	12.00	8.00
10. Manholes, 0 to 6-ft. deep	6 ea.	80.00	100.00
21. Manholes, 6 to 10-ft. deep	2 ea.	90.00	125.00
22. Manholes, 10 to 12-ft. deep	1 ea.	100.00	300.00
24. Manholes, 12 to 16-ft. deep	1 ea.	130.00	350.00
25. Catch basins, 0 to 6-ft. deep	6 ea.	85.00	100.00
26. Class A concrete	1,500 c. y.	22.00	50.00
27. Class B concrete	200 c. y.	18.00	15.00
28. Expansion joints	150 l. f.	.40	3.00
29. Steel reinforcement	110 ton	120.00	160.00
30. B. & S. cast iron pipe	20 ton	120.00	210.00
31. B. & S. cast iron specials	7 ton	200.00	290.00
32. Flanged cast iron pipe	5 ton	200.00	270.00
33. Flanged cast iron specials	3 ton	300.00	400.00
34. Cast iron wall casting	1.5 ton	250.00	410.00
35. Ext. hvy. c. i. soil pipe	2 ton	110.00	300.00
36. Cast iron floor drains	200 lb.	.30	1.00
37. 1½-in. black wrt. iron pipe	300 l. f.	.40	1.05
38. 2-in. black wrt. iron pipe	130 l. f.	.50	2.20
39. 2½-in. black wrt. iron pipe	630 l. f.	.60	2.40
40. 4-in. black wrt. iron pipe	60 l. f.	.70	6.00
41. 6-in. black wrt. iron pipe	25 l. f.	.80	10.00
42. 1-in. Everdur pipe	25 l. f.	2.00	6.60
43. 2-in. brass pipe	90 l. f.	1.00	4.20
44. 1½-in. quick-opening valves	12 ea.	8.00	15.00
45. 2-in. screw end gate valves	2 ea.	10.20	10.00
46. 3-in. screw end gate valves	1 ea.	14.40	20.00
47. 6-in. hub end gate valves	3 ea.	29.60	50.00
48. 8-in. hub end gate valves	1 ea.	45.75	80.00
49. 10-in. hub end gate valves	3 ea.	68.80	130.00
50. 12-in. hub end gate valves	1 ea.	95.35	175.00
51. 4-in. flanged end gate valves	2 ea.	21.50	45.00
52. 6-in. flanged end gate valves	15 ea.	33.00	60.00
53. 8-in. flanged end gate valves	13 ea.	48.00	80.00
54. 2½-in. plug valves	8 ea.	12.50	25.00
55. 2-in. screw end check valves	2 ea.	8.00	15.00
56. 2½-in. screw end check valves	4 ea.	10.00	20.00
57. 6-in. flanged end check valves	3 ea.	33.00	75.00
58. 8-in. flanged end check valve	2 ea.	55.00	120.00
59. 6-in. mud valve	1 ea.	31.00	70.00
60. 4-in. fire hydrant	1 ea.	75.00	75.00
61. 1-in. lawn hydrant	2 ea.	30.00	25.00
62. 2-in. relief valve	1 ea.	38.00	65.00
63. Floor stands	11 ea.	35.00	60.00
64. Extension stems	175 l. f.	1.00	4.00
65. Valve boxes	110 l. f.	1.50	5.00
66. Aluminum plates, etc	900 lb.	1.65	2.00
67. Aluminum floor gratings	335 s. f.	3.70	5.00
68. Bronze tablet	L. S.	100.00	125.00
69. Addl. 1½-in. pipe railing	300 l. f.	3.00	3.00
70. Addl. structural steel	2 ton	280.00	300.00
71. Addl. ornamental iron	1,000 lb.	.60	.20
72. Mechan. cl. bar screen, etc	L. S.	3,400.00	3,375.00
73. Grit collector, etc	L. S.	5,600.00	5,455.00
74. Sludge collectors	L. S.	4,350.00	11,300.00
75. Sewage pumps	L. S.	2,500.00	3,620.00
76. Sludge pump	L. S.	1,[illegible]0.00	1,250.00
77. Sump pump	L. S.	0.00	160.00
78. Independent water supply	L. S.	1,200.00	3,000.00
79. Digestor equipment	L. S.	17,000.00	15,320.00
80. Engine—generator	L. S.	4,600.00	9,980.00
81. Chlorinating equipment	L. S.	5,875.00	6,500.00
82. Chemical feed equipment	L. S.	725.00	1,675.00
83. Flow recorder	L. S.	1,050.00	1,100.00
84. Regulator equipment	L. S.	1,550.00	2,400.00
85. Superstructures	L. S.	26,000.00	52,000.00
86. Painting	L. S.	900.00	3,000.00
87. Painting digestor equipment	L. S.	200.00	2,000.00
88. Miscellaneous equipment	L. S.	1,500.00	3,925.00
89. Parking areas, roads, etc	L. S.	4,800.00	8,000.00

Section No. 2—Outfall Sewer

1. Thomas Proctor Co., Long Branch, N. J. (contract) $77,786
2. Joseph Miele Constr. Co., Maplewood, N. J. 99,787
3. Spiniello Constr. Co., Newark, N. J. 106,745
4. Clevorock Inc., New York, N. Y. 129,950

1. Excavation, unclassified	500 c. y.	$1.00	$5.00	$0.01
2. Rock excavation	100 c. y.	6.00	2.00	.01
3. Timber and lumber	160 M bm.	60.00	99.00	.01
4. Steel sheet piling	10 ton	100.00	108.00	.01
5. Wood piles, creosoted	1,000 l. f.	1.00	2.00	1.60
6. Pile anchors	200 lb.	.15	.20	.15
7. 4 to 6-in. underdrain	2,500 l. f.	.80	.36	.40
8. Crushed stone	200 c. y.	4.00	7.00	3.00
9. Class A concrete	20 c. y.	30.00	35.00	28.00
10. Class B concrete	200 c. y.	25.00	22.50	16.00
11. Steel reinforcement	5 ton	100.00	180.00	240.00
12. 30-in. rein. conc. pipe, 0-6-ft. deep	625 l. f.	5.75	9.50	9.00
13. 30-in. rein. conc. pipe, 6-8-ft. deep	340 l. f.	6.25	10.60	14.00
14. 30-in. rein. conc. pipe, 8-10-ft. deep	450 l. f.	7.00	11.80	18.00
15. 30-in. rein. conc. pipe, 10-12-ft. deep	290 l. f.	8.25	13.00	25.00
16. 30-in. rein. conc. pipe, 12-14-ft. deep	340 l. f.	10.50	14.50	26.25
17. 30-in. rein. conc. pipe, 14-16-ft. deep	700 l. f.	11.50	16.00	28.00
18. Manholes, 0 to 6-ft. deep	3 ea.	80.00	125.00	78.00
19. Manholes, 6 to 8-ft. deep	1 ea.	85.00	140.00	88.00
20. Manholes, 8 to 10-ft. deep	1 ea.	100.00	160.00	100.00
21. Manholes, 12 to 14-ft. deep	2 ea.	125.00	250.00	125.00
22. Manholes, 14 to 16-ft. deep	1 ea.	200.00	300.00	140.00
23. Outfall manhole	L. S.	1,400.00	6,000.00	3,400.00
24. Railroad crossing	L. S.	2,500.00	4,000.00	3,700.00
25. 16-in. wrought iron ocean outfall	L. S.	26,000.00	22,000.00	33,000.00
26. Road restoration	2,500 l. f.	1.00	.60	1.35

Section No. 3—Interceptor Sewer

1. Thomas Proctor Co., Long Branch, N. J (contract) $193,713
2. Joseph Miele Constr. Co., Maplewood, N. J. 214,812

1. Excavation, unclassified	2,000 c. y.	$1.00	$5.00
2. Rock excavation	100 c. y.	7.50	2.00
3. Timber and lumber	200 M bm.	90.00	99.00
4. Steel sheet piling	10 ton.	100.00	100.00
5. Wood piles, creosoted	500 l. f.	1.00	2.00
6. Pile anchors	100 lb.	.15	.16
7. 4 to 6-in. underdrains	2,500 l. f.	1.00	1.00
8. Crushed stone	350 c. y.	4.00	7.00
9. Class A concrete	50 c. y.	30.00	35.00
10. Class B concrete	800 c. y.	20.00	20.00
11. Steel reinforcement	5 ton	100.00	150.00
12. 8-in. vitr. clay pipe, 0 to 6-ft. deep	580 l. f.	1.60	2.35
13. 8-in. vitr. clay pipe, 6 to 8-ft. deep	285 l. f.	1.80	2.50
14. 8-in. vitr. clay pipe, 8 to 10 ft. deep	600 l. f.	2.00	3.20
15. 8-in. vitr. clay pipe, 10 to 12-ft. deep	320 l. f.	2.20	3.75
16. 8-in. vitr. clay pipe, 12 to 14-ft. deep	230 l. f.	2.40	5.00
17. 8-in. vitr. clay pipe, 14 to 16-ft. deep	140 l. f.	2.60	6.45
18. 12-in. vitr. clay pipe, 0 to 8-ft. deep	2,050 l. f.	2.50	3.00
19. 12-in. vitr. clay pipe, 8 to 10-ft. deep	3,680 l. f.	4.00	3.60
20. 12-in. vitr. clay pipe, 10 to 12-ft. deep	1,575 l. f.	4.20	4.00
21. 12-in. vitr. clay pipe, 12 to 14-ft. deep	575 l. f.	4.50	6.50
22. 12-in. vitr. clay pipe, 14 to 16-ft. deep	50 l. f.	4.80	6.70
23. 15-in. vitr. clay pipe, 0 to 6-ft. deep	770 l. f.	2.00	3.15
24. 15-in. vitr. clay pipe, 6 to 8-ft. deep	275 l. f.	2.50	3.50
25. 15-in. vitr. clay pipe, 8 to 10-ft. deep	330 l. f.	2.75	4.10
26. 15-in. vitr. clay pipe, 10 to 12-ft. deep	270 l. f.	3.00	4.70
27. 15-in. vitr. clay pipe, 12 to 14-ft. deep	470 l. f.	5.00	6.50
28. 15-in. vitr. clay pipe, 14 to 16-ft. deep	100 l. f.	5.00	7.00
29. 18-in. rein. conc. pipe, 0 to 6-ft. deep	140 l. f.	2.25	3.25
30. 18-in. rein. conc. pipe, 6 to 8-ft. deep	1,310 l. f.	3.00	4.00
31. 18-in. rein. conc. pipe, 8 to 10-ft. deep	1,980 l. f.	4.00	5.00
32. 18-in. rein. conc. pipe, 10 to 12-ft. deep	2,450 l. f.	5.00	5.50
33. 18-in. rein. conc. pipe, 12 to 14-ft. deep	1,160 l. f.	5.00	7.50
34. 18-in. rein. conc. pipe, 14 to 16-ft. deep	950 l. f.	5.50	8.40
35. 18-in. rein. conc. pipe, 16 to 18-ft. deep	740 l. f.	6.00	9.40
36. 18-in. rein. conc. pipe, 18 to 20-ft. deep	560 l. f.	8.00	10.80
37. 21-in. rein. conc. pipe, 0 to 12-ft. deep	800 l. f.	8.00	7.00
38. 21-in. rein. conc. pipe, 12 to 14-ft. deep	1,350 l. f.	8.50	8.00
39. 21-in. rein. conc. pipe, 14 to 16-ft. deep	490 l. f.	9.50	10.00
40. 30-in. rein. conc. pipe, 12 to 14-ft. deep	190 l. f.	9.50	11.25
41. Manholes, 0 to 6-ft. deep	15 ea.	65.00	110.00
42. Manholes, 6 to 8-ft. deep	15 ea.	75.00	125.00
43. Manholes, 8 to 10-ft. deep	25 ea.	85.00	150.00
44. Manholes, 10 to 12-ft. deep	16 ea.	90.00	170.00
45. Manholes, 12 to 14-ft. deep	12 ea.	95.00	225.00
46. Manholes, 14 to 16-ft. deep	8 ea.	100.00	285.00
47. Manholes, 16 to 18-ft. deep	3 ea.	125.00	360.00
48. Manholes, 18 to 20-ft. deep	1 ea.	150.00	475.00
49. 8x4-in. vitr. clay wyes	50 ea.	2.00	2.00
50. 12x4-in. vitr. clay wyes	70 ea.	3.00	3.00
51. Inverted siphon	L. S.	4,000.00	2,000.00
52. Railroad crossing	L. S.	1,500.00	2,000.00
53. Connections to exist. sewers	L. S.	420.00	200.00
54. Moving garages	L. S.	800.00	2,000.00
55. Sidewalk replacement	2,000 s. f.	.30	.30
56. Curb replacement	600 l. f.	1.25	1.20
57. Pavement replacement	24,000 l. f.	1.00	.25

90-DAY PIER JOB BUILT IN 43 DAYS

'INCOR' SPEEDS CONCRETING ON 700-FT. NAVY PROJECT

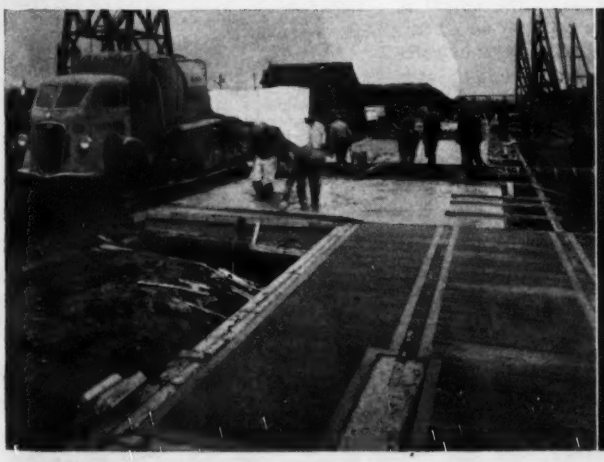
Foreman of George W. Rogers Construction Co. paints a "3" over the "5" on sign at pier site—signalizing completion 2 days ahead of the 45-day schedule for a 90-day job! Below, left, pier before completion; right, placing 'Incor' concrete at night.

CONTRACT for 700-ft. Navy pier for Bethlehem Steel Corporation called for 90-day completion. Then came the Navy's order to "double shift it." This meant a 30-day saving—but the pier was needed even quicker than that. So George W. Rogers Construction Co., New York, re-scheduled every detail of the job and came up with an estimated figure of 45 days.

Scant time, indeed, in which to drive 42,700 ft. of piling, frame 200,000 board feet of creosoted timber, and place 22,700 sq. ft. of concrete deck—in late winter sleet and fog. Good job planning, teamwork between management and men—and 'Incor'* concrete, placed one day, carrying cranes and heavy equipment the next—did the trick.

As George W. Rogers, President of the Contracting firm, puts it: "When it came to concreting, my worries were over—as a confirmed 'Incor' user I knew I could rely on it to get the job finished on time—or sooner. In fact, this job was turned over to the Navy *in the record time of 43 days!*" *Reg. U.S. Pat. Off.

Time Won't Wait . . . Use 'Incor'

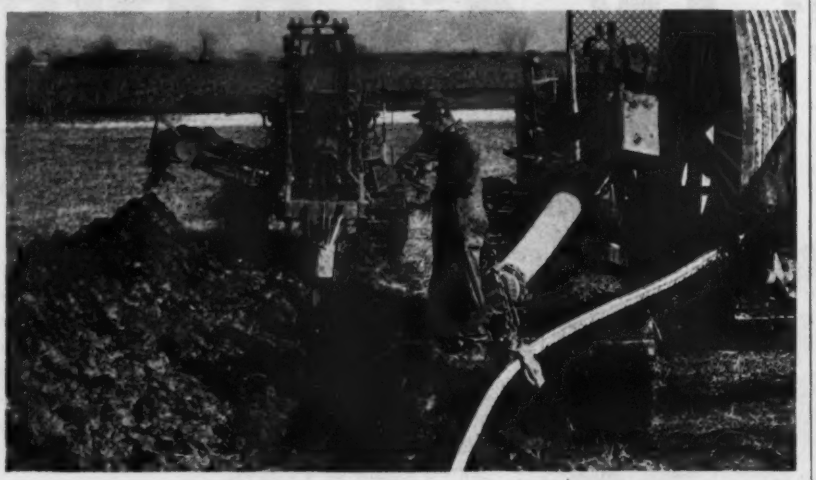


LONE STAR CEMENT CORPORATION

Offices: ALBANY • BIRMINGHAM • BOSTON • CHICAGO • DALLAS • HOUSTON • INDIANAPOLIS • JACKSON, MISS. KANSAS CITY • NEW ORLEANS • NEW YORK • NORFOLK • PHILADELPHIA • ST. LOUIS • WASHINGTON, D. C.

New Aids to the Constructor

Equipment and material announcements and manufacturers' news



Trencher clears way for underground cable

A unit of the American Telephone & Telegraph Company is shown employing a fast, compact Model 12 Buckeye trencher to dig trench 15 in. wide and up to 5 ft. 6 in. deep in places for the placement of telephone cables and wires. The trencher is followed up by the crawler-mounted cable laying rig. The manufacturer builds both digging wheel and ladder type trenchers for utilities and telephone companies, the machine shown employing a digging wheel. The ladder type is used for undercutting.—*Buckeye Traction Ditcher Company, Findlay, Ohio.*

Pier Form

A new product, the Beacon pier form, a fiber tube fabricated for this specific purpose has been developed by Beacon Steel Products Company. The form may be easily installed with carpenters' tools and may be left in place. Use is said to eliminate high construction costs, varying proportions, and the necessary stripping, cleaning, oiling and nailing operations. The new product has compression strength capable of withstanding any pour.—*The Beacon Steel Products Company, Inc., 12 E. 41st St., New York, N. Y.*

Tracing Cloth

Penciltex, a pencil tracing cloth, enables draftsmen to turn out more work in a given time than has been possible before. Every pencil mark or line on Penciltex is dense and sharp because the processed, velvety surface of this tracing cloth takes pencil perfectly. It is tough, durable and will not discolor with age. Its glossy, stay-clean back is an added feature and its extra transparency adds speed to print production. The cloth is anti-smudge, permitting the use of 5H or harder pencil and produces the same dark, dense line as a 2H or 3H on ordinary tracing cloth.—*The Frederick Post Company, Chicago, Ill.*

New Scraper

A new and improved scraper for use with International TD-18 TracTracTors or other tractors of similar size has been announced by the J. D. Adams Company. This scraper, known as the No. 90, has a heaped capacity of 10 cu.yd. Drop center bowl provides quick penetration and balanced loading while four large low pressure tires, over which the weight is evenly distributed, provide for easy hauling and plenty of flotation in soft material. A 70-deg. dumping angle insures free discharge of the material which can be spread evenly to any desired depth.

Frame is all welded, box-type construction with full oscillating front axle and tongue.—*J. D. Adams Company, Indianapolis, Ind.*

Blackout Board

More than 47,000 panes of glass in an important West Coast defense plant recently were replaced with the same num-

Here Is Your Nearest Worthington Distributor

For Sales, Rentals and Service on BLUE BRUTE Portable Compressors, Rock Drills and Air Tools. Get your EQUIPMENT-SAVER — FREE
see full page ad page 101

ALABAMA
Birmingham — Ed Gantt Machinery Company
ARIZONA
Phoenix — Smith Booth Usher Company
ARKANSAS
Fort Smith — R. A. Young & Son
Little Rock — R. A. Young & Son
CALIFORNIA
Los Angeles — Smith Booth Usher Company
San Francisco — Valley Equipment Company
COLORADO
Boulder — Standard Machine Works
Denver — Morse Bros. Machinery Company
CONNECTICUT
Hartford — Holmes-Talcott Company
GEORGIA
Atlanta — Tractor & Machinery Co., Inc.
IDAHO — Twin Falls — Nelson Equipment Co.
ILLINOIS — Chicago — Kennedy-Cochran Co.
Rock Island — Western Equipment & Supply Co.
INDIANA
Indianapolis — Reid-Holcomb Company
IOWA — Des Moines — Electrical Eng. & Constr. Co.
KENTUCKY — Harlan — Hall Equipment Sales
Louisville — Engineering Sales Company
LOUISIANA
New Orleans — Wm. F. Surgi Equipment Company
MAINE — Ellsworth — Murray Machinery Co.
MARYLAND
Baltimore — D. C. Elphinstone, Inc.
MASSACHUSETTS
Boston — P. I. Perkins Company
Cambridge — W. W. Field & Son, Inc.
MICHIGAN
Detroit — W. H. Anderson Company, Inc.
MINNESOTA
Minneapolis — George T. Ryan Company
MISSOURI
Kansas City — Machinery & Supplies Company
St. Louis — Webster & Hedgcock Tr. & Eq. Co.
MONTANA — Helena — Caird Engineering Works
NEBRASKA
Lincoln — Highway Equipment & Supply Co.
NEW JERSEY
Irvington — Smith Tractor & Equip. Co., Inc.
NEW MEXICO
Albuquerque — The Harry Cornelius Company
NEW YORK
Albany — Larkin Equipment Company
Binghamton — MacDougall Equipment Co.
Buffalo — Dow & Company, Inc.
Glens Falls — Collin, Fox Co., Inc.
Middleton — S. T. Randall, Inc.
New York — Morris Park Construction Co.
Olean — Freeborn Equipment Company
Oneonta — L. P. Butts, Inc.
Syracuse — Harrod Equipment Company
Troy — Briggs Machinery Company, Inc.
NORTH CAROLINA
Durham — Constructors Supply Company, Inc.
OHIO — Cincinnati — Finn Equipment Company
Cleveland — Gibson-Stewart Company
Marietta — Northwest Supply & Equipment Co.
Toledo — M. W. Kilcorse & Company
OKLAHOMA
Oklahoma City — Townsco Equipment Co.
OREGON
Portland — Andrews Equipment Service
PENNSYLVANIA
Allentown — H. N. Crowder, Jr. Co.
Easton — Sears & Bowers
Harrisburg — N. A. Coulter
Oil City — Freeborn Equipment Company
Philadelphia — Metalweld, Inc.
Pittsburgh — John McC. Latimer Company
Wilkes-Barre — Ensminger & Company
SOUTH CAROLINA
Columbia — Bell-Lott Road Machinery Co.
TENNESSEE
Chattanooga — James Supply Company
Memphis — Tri-State Equipment Company
TEXAS — Dallas — Shaw Equipment Company
Houston — McCall Tractor & Equipment Co.
San Antonio — Patten Machinery Company
UTAH
Salt Lake City — James A. Wade Company
VIRGINIA
Richmond — Highway Machinery & Supply Co.
WASHINGTON
Seattle — Star Machinery Company
Spokane — General Machinery Company
WEST VIRGINIA
Fairmont — Interstate Engineers & Constructors
WISCONSIN
Eau Claire — Bradford Machinery Company
Green Bay — Nelson Machinery Company
Madison — Western Equipment Company
WYOMING
Cheyenne — Wilson Equipment & Supply Co.

Get more WORTH from air with WORTHINGTON

Blue Brute Beams

Worthington Pump and Machinery Corp.

THIS BRUTE SAVES ITS BREATH...

This two-fisted, rugged rock drill stays on the job longer — with no air-wasting "back-talk."

Worthington's Blue Brute Rock Drill (WJ-55) saves *your* breath, too, for you don't waste hell and damnation on a tool that is easy on the operator and rarely interrupts the work for maintenance and repairs.

All Worthington Blue Brutes are like that. Rock drills and air tools, designed for a complete range of jobs . . . from hardest rock to clay or fitchery earth . . . *use less air,* cause less trouble, save time and money in the long run. Portable and semi-portable compressors . . . gasoline-driven, diesel, electric . . . equipped with Worthington's time-tested "Feather* Valves" . . . *deliver more air,* more smoothly, more economically.

Get a demonstration, *now, on your present job,* of how Blue Brutes will help you get more WORTH from air!

FREE EQUIPMENT SAVER

Ask your nearest Worthington distributor, listed on page 100, for the free EQUIPMENT SAVER which shows you how to conserve scarce metals, lowering maintenance costs for all Blue Brute users from coast to coast. If your distributor is not listed, let us send you this free cost-cutting aid to efficient production direct from Holyoke.

*Reg. U. S. Patent Off.

On the Job with

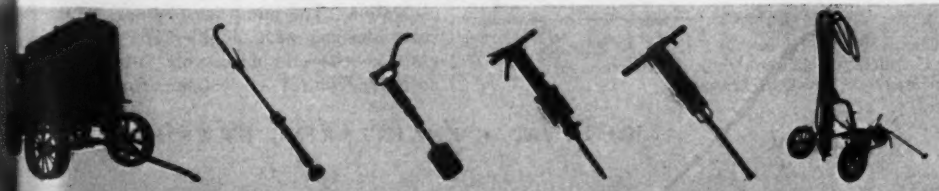
BLUE BRUTES

A Worthington Blue Brute WJ-55 Rock Drill, on trial at a western quarry, made such a hit with the operators that they tried to keep it by *hiding* it when the trial was over! Said the Super, after buying: "It out-drills all our competitive makes by 2 or 3 inches per minute."

On hundreds of army, navy, air-force and ordnance projects all over the country, Blue Brutes are at work.

Get more WORTH from air with WORTHINGTON

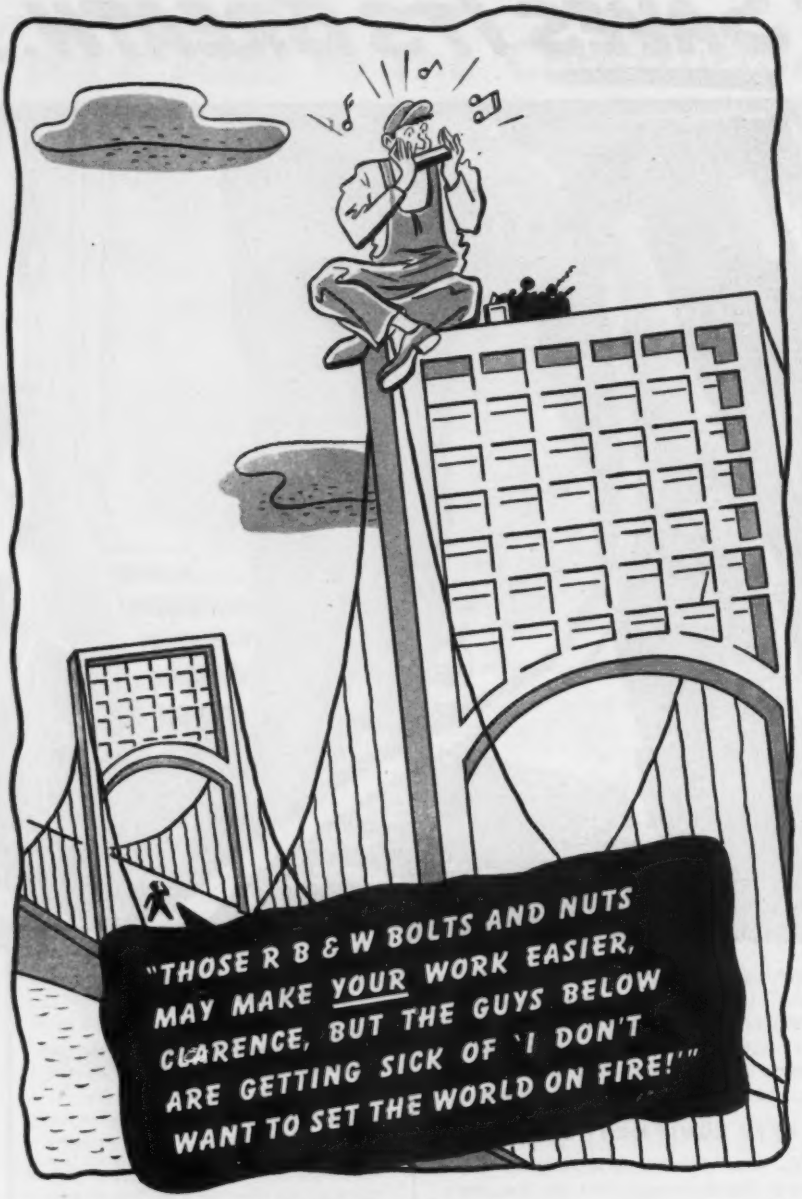
BUY BLUE BRUTES



ompressors from 60 to 500 cu. ft. capacity in mount-gs to suit all jobs. Rock Drills and Air Tools that have always set the pace for easy operation — available in a wide range of weights and sizes.

WORTHINGTON

Worthington Pump and Machinery Corporation, Harrison, N. J. Holyoke Compressor and Air Tool Department, Holyoke, Massachusetts


"THOSE R B & W BOLTS AND NUTS
MAY MAKE YOUR WORK EASIER,
CLARENCE, BUT THE GUYS BELOW
ARE GETTING SICK OF 'I DON'T
WANT TO SET THE WORLD ON FIRE!'"

Use R B & W Bolts and Nuts . . .

Quick-starting, quick-tightening because they are accurately, uniformly sized and threaded — and carefully inspected.

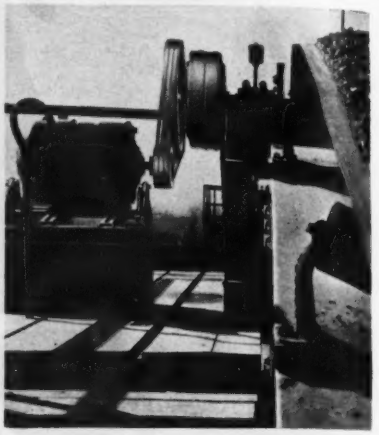
Vibration-resisting, shock-resisting because the manufacturing method insures extra strength, and all processing is controlled from raw rod to finished product.

EMPIRE AND ALLIED FASTENING PRODUCTS . . . SINCE 1845

RB&W *Making strong the things that make America strong*

Russell, Burdsall & Ward Bolt and Nut Company. *Factories at* Port Chester, N. Y., Rock Falls, Ill., Coraopolis, Pa.; *sales offices at* Philadelphia, Chicago, Detroit, Chattanooga, Los Angeles, San Francisco, Portland, Seattle

ber of pieces of Celotex Backer Board as a blackout protection. The board is ⅛ in. thick made of fibrous felt, saturated with weather-resistant asphalt. Because of its economy, many dealers are furnishing it for blackout purposes. It is customarily nailed to a light frame which is then secured around window apertures. As an additional protection, the board is sometimes reinforced with 1 in. wire mesh.—*The Celotex Corp., 919 N. Michigan Ave., Chicago, Ill.*



Reduction Drives

Shown above are an American Econ-O-Matic V-belt drive and an American Reduction drive, mounted on a conveyor headshaft at the new crushed-stone plant at Columbia, S. C. Seven of these conveyors are operated by 5 hp. at 1,740 r.p.m. motors, mounted on American motor bases which provide automatic control of belt tension, keep average tension low and thus assure doubled belt life. This tension-control base is an integral part of every Econ-O-Matic drive. Directly on each conveyor's head shaft, without need for separate foundation, is mounted an American reduction drive which provides a 13:1 speed reduction with high efficiency (friction losses not over 1.5%).—*The American Pulley Co., Philadelphia, Pa.*

Plastics in Pumps

Milton Roy Pumps is offering an improved model plastics pump in which the step-valve and inlet and discharge connections are made entirely from transparent plastics. The pump is recommended for handling alum solutions, hypochlorites, weak acids, mineral and animal oils and many other liquids, the "Plexiglas" valve being unaffected by most inorganic solutions and by alkalis and oxidizing acids only in high concentrations. The pump is of typical step-valve design, with double-ball ground glass checks and adjustable stroke for accurate control of volume from one

2042 A.D.

• The shapes and forms that will carve the skyline in 2042 A.D. can only be guessed at. Their design is on the blueprints of the future. Being manufactured and installed today, however, are smooth-flowing pipe lines that will underlie the cities of tomorrow. Lock Joint Pressure Pipe Lines are constructed and laid with an eye to the demands of distant generations. A century of useful service, immune to tuberculation and corrosion, maintaining their original high carrying capacity and original strength! The life expectancy of Lock Joint Reinforced Concrete Pressure Pipe Lines should make them your best investment in 1942. Whether your project is large or small, your 'phone call, telegram, cable or letter to any of our offices, will bring a prompt reply.

LOCK JOINT PIPE COMPANY

Established 1905

AMPERE, NEW JERSEY

Denver, Colo. • Chicago, Ill. • Kenilworth, N. J. • Kansas City, Mo. • Rock Island, Ill.
White Plains, N. Y. • Valley Park, Mo. • Cleveland, Ohio • Hartford, Conn. • Navarre, Ohio

SCOPE OF SERVICES

Lock Joint Pipe Company specialize in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply Mains as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.

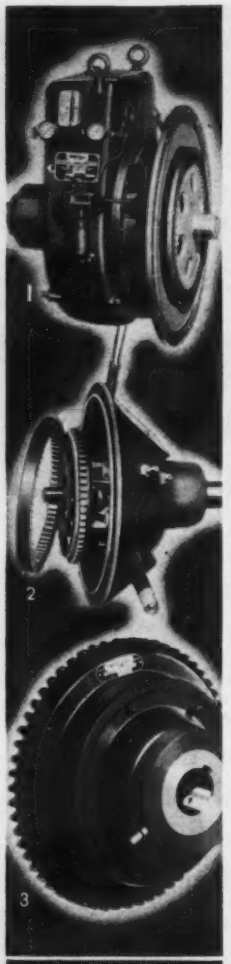
LOCK JOINT
Reinforced Concrete
PRESSURE PIPE

No time to lose!

America at war cannot afford a single minute of lost production due to breakdowns or preventable delays. Every minute saved brings us closer to our goal: Winning the War!

In all types of production machinery, Twin Disc Clutches are giving the dependable service that only years of research and specialization can assure.

No matter where your plant may be located, you can be sure of competent service or parts for your Twin Disc Clutches, Power Take-offs or Hydraulic Drives. Strategically located throughout the country are 7 factory branches and 30 parts stations, all prepared to meet your service and parts need at any hour of the day or night. Complete stock of parts assures prompt shipment, even for exceptional or unusual demands. This complete service organization protects you against interrupted production, helps you to maintain emergency schedules. TWIN DISC CLUTCH COMPANY, 1327 Racine Street, Racine Wisconsin.



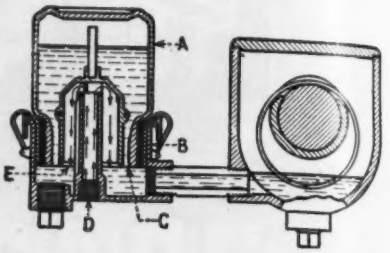
1. Twin Disc Hydraulic Torque Converter. In considering installation, ask for complete data and specific recommendations. 2. Twin Disc Model E Clutches, heavy-duty, enclosed type. Sizes: 14" to 42" in single or two-plate assemblies. 3. Twin Disc Power Take-off for engines having up to 285 hp. output. Sizes: with single plate clutches, 6½" to 24"; double plate, 11½" to 18". Housing sizes: No. 6 S.A.E. to No. 00 S.A.E.

Twin Disc replacement parts in these cities:

Alabama: Montgomery, Parts Service Corp. **California:** Los Angeles, Charles W. Carter Co.; San Francisco, Charles W. Carter Co. **Colorado:** Denver, Liberty Trucks & Parts Co. **Florida:** Jacksonville, Motor Parts & Supply Co. **Illinois:** Chicago, Wisconsin Industrial Parts. **Kansas:** Great Bend, Scheufler Supply Co. **Kentucky:** Lexington, Wombwell Auto Parts Co. **Louisiana:** New Orleans, Mechanical Equip. Co. **Maine:** Portland, Southworth Machine Co. **Massachusetts:** Boston, Rapp Huckins Co., Inc. **Michigan:** Detroit, W. C. Ducomb Co., Inc. **Minnesota:** St. Paul, Truck Parts, Inc. **Missouri:** St. Louis, Twin Disc Clutch Co. **New York:** Buffalo, Edward W. Rode; New York, Twin Disc Clutch Parts & Service of New York, Inc. **Ohio:** Cincinnati, C. McCash; Cleveland, Twin Disc Clutch Co.; Cleveland, Industrial Engine Parts. **Oklahoma:** Tulsa, Twin Disc Clutch Co. **Pennsylvania:** Philadelphia, Twin Disc Clutch Parts & Service of Philadelphia; Pittsburgh, Contractors Equip. Ser. Co. **Tennessee:** Knoxville; Automotive Equip. & Supply Co.; Memphis, Choctaw Culvert & Mach. Co. **Texas:** Dallas, Twin Disc Clutch Company; Fort Worth, John Muller Co.; Houston, Portable Rig Co., Inc.; John Muller Co. **Utah:** Salt Lake City, Lund Machinery Co. **Virginia:** Richmond, Standard Parts Corp. **Washington:** Seattle, Twin Disc Clutch Co.

TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES
REG. U.S. PAT. OFF.

quart per hour up to maximum capacity. Duplex models will handle up to 100 g.p.h. Simplex models up to 50 g.p.h., against pressures as high as 150 lb. per sq. in.—*Milton Roy Pumps, 1300 E. Mermaid Ave., Philadelphia, Pa.*



Lubricators

Of importance for the protection of vital machinery is the new Oil-Rite constant level lubricator which holds a visible reserve supply of oil and releases automatically just as much as is needed to maintain a constant predetermined level of lubricant. Its use is said to insure adequate lubrication at all times and prevent oil waste and the deterioration or spoilage of material caused by oil throw. The lubricator is used on electric motors, pillow blocks, textile and paper making machinery, pumps, air conditioning equipment, gear boxes and wherever bearings and other machinery parts must be provided with an ample supply of lubrication. When the reservoir (a) in the accompanying diagram, is filled and inverted into position on the base (b), the lower edge (e) of the inverted bucket or bell determines the oil level which the lubricator will retain. When the level falls below the point, air from the vent (d) escapes under the side of the bell permitting oil to flow down until the level to be maintained again seals across the base of the bell. No moving parts are employed.—*Oil-Rite Corporation, 3466 S. 13th St., Milwaukee, Wis.*

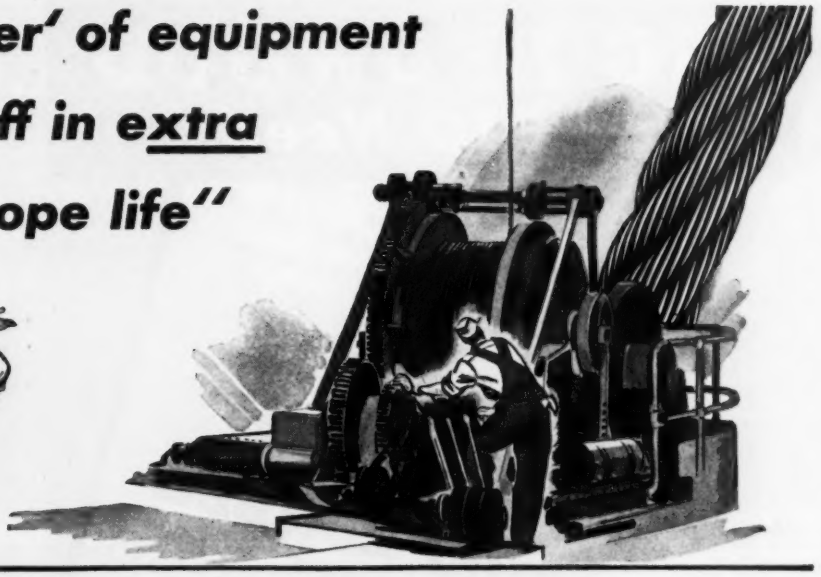
Data Sheets

The first of a series of data sheets completely covering the subject of induction heating has been issued by the Induction Heating Corp. Similar sheets will be issued monthly, starting with the present month, and will be furnished to interested engineers upon application. The first issue confines itself to a definition of terms to be used in forthcoming issues. —*Induction Heating Corp., 389 Lafayette St., New York, N. Y.*

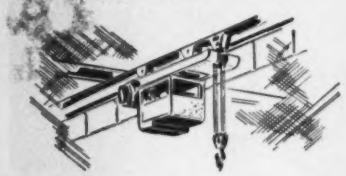
Photoswitch Control

Photoswitch Incorporated have developed a photoelectric control for the purpose of providing a warning signal inside factories in the event of an air raid. Most large power plants and de-

"This 'once-over' of equipment pays off in extra wire rope life"



"If you're out to get a full measure of service from your wire ropes, it's just good, common sense to check the equipment it runs on. Not just when you get around to it, but regularly —carefully and often. Make a close check-up when a new rope is installed ...and then check again, frequently— *before* the rope starts to show signs of wear. Take a crane for example, with a worn sheave.



It will go right along handling every bit of work it always did. But that sheave will cut and squeeze the wires ...and the rope will be through, long before its time.

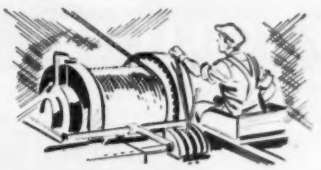
Here are some of the things to look for—some of the reasons why you often hear an operator blame the rope when it was really his own equipment that shortened its life.

First, see if any sheaves are out of alignment. Then check for deeply worn grooves with a gauge,—like this...

The grooves may be scored by an old rope or one of them may have a broken rim that calls for replacement. Sheaves may turn hard or wabble because of worn or damaged journals. That's tough on your ropes, too.

It's easy to realize the jerk or shock at the fastening when a wire rope whips. Vibration has the same kind of effect, building up a great many small shocks. Too much play in the rope may be to blame...even a bent shaft.

Check for displaced or faulty rope guards. Then find out from the operators if there are any clutches that stick or grab...loose bearings or anything else that causes the pull on a rope to be uneven or jerky.

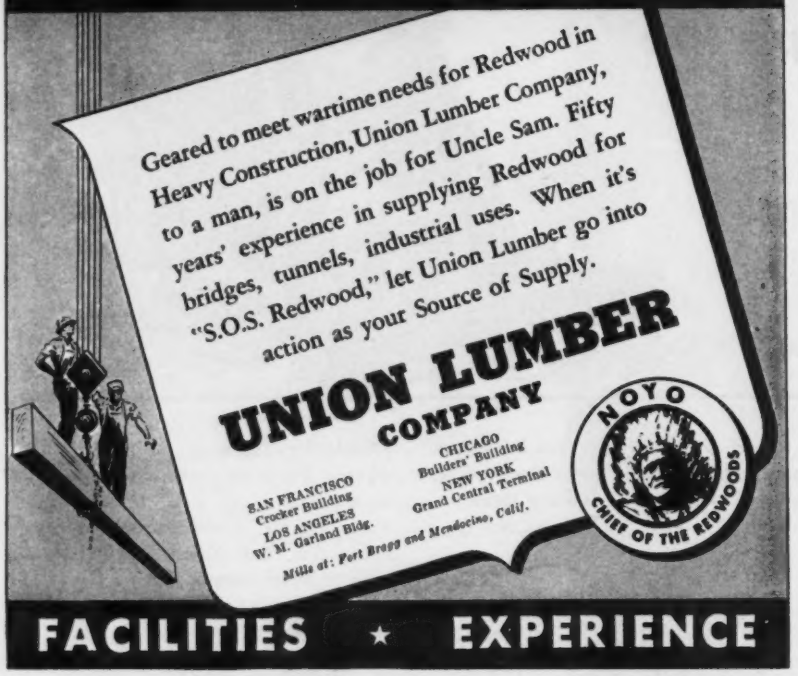


And remember to consult your wire rope manufacturer on any special problems. There are local representatives near you who have practical experience in ferreting out any "bugs" in your equipment that may be keeping your wire ropes from delivering a maximum of service."

JOHN A. ROEBLING'S SONS COMPANY
TRENTON, NEW JERSEY
Branches and Warehouses in Principal Cities

ROEBLING
"Blue Center"
STEEL WIRE ROPE
PREFORMED OR NON-PREFORMED

BIG REDWOOD
for BIG Needs



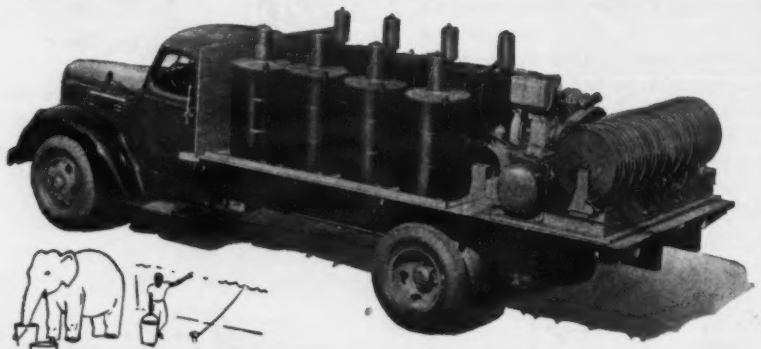
Geared to meet wartime needs for Redwood in Heavy Construction, Union Lumber Company, to a man, is on the job for Uncle Sam. Fifty years' experience in supplying Redwood for bridges, tunnels, industrial uses. When it's "S.O.S. Redwood," let Union Lumber go into action as your Source of Supply.

UNION LUMBER COMPANY

SAN FRANCISCO, Crocker Building
LOS ANGELES, W. M. Garland Bldg.
CHICAGO, Builders' Building
NEW YORK, Grand Central Terminal
Mills at: Port Bragg and Mendocino, Calif.

NOYO — CHIEF OF THE REDWOODS

FACILITIES ★ EXPERIENCE



NO LUBRICATION JOB TOO BIG FOR GRACO CONVOY LUBERS

This giant convoy Luber was custom built for a big defense job. With 10 hose reels and eight powerful lubricant pumps it dispenses chassis lubricant, two gear lubricants, track roller lubricant, hydraulic hoist oil, three grades of motor oil, and compressed air. It employs a 16 cubic ft. air compressor powered by a 6 h. p. gasoline engine. An auxiliary lighting plant furnishes 1000 watts 110 volt 60 cycle current for lighting night operations.

Like all Graco Convoy Lubers this unit is shipped complete with all necessary hand guns, tools and accessories in convenient drawers at the rear of the unit.

GRACO

GRAY COMPANY, INC. MANUFACTURERS OF HIGH QUALITY LUBRICATING EQUIPMENT • *Minneapolis, Minn.*

fense factories are now on 24-hour shifts, and tests have proved that in many cases it is impossible to hear external air raid warning sirens. The Photoswitch control is placed in a convenient location so that it views a centrally controlled street lamp. Through the photoswitch are connected alarm systems operating inside the factory, and when street lights are turned out, the photoswitch sounds the alarm. The control is designed to operate independent of a momentary flickering of the street lamp; also independent of ambient light conditions.—*Photoswitch, Incorporated, 21 Chesthut St., Cambridge, Mass.*

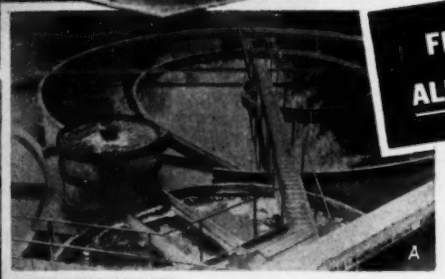
Acousti-Booth

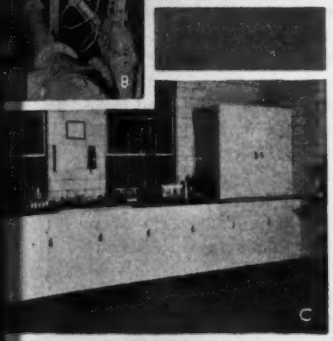
A new wooden acousti-booth, finished in walnut color, is announced by the Burgess Battery Company, Acoustic Division. This new booth is part of a line of wooden booths being developed to enable the company to supply industrial users without priorities or other restrictions. The walls and ceilings in the new Model 210 Acousti-Booth are constructed of heavy reinforced birch plywood panels, filled with a thick blanket of sound-absorbent material. The inside walls consist of a heavy perforated plywood facing, which protects the sound-absorbent material. This combination of perforated plywood and the sound-absorbent material which it protects is a patented development which blots up factory noise and creates a remarkable zone of quiet

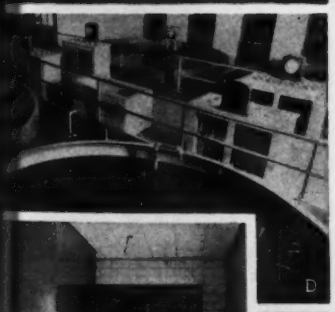
A MODERN ALL-STEEL FILTRATION PLANT for Beckley, West Virginia

by PITTSBURGH •DES MOINES

FROM AERATOR TO RESERVOIR— ALL WATER HANDLING EQUIPMENT IS STEEL







-A- Mixing chamber, aerator, and sedimentation basins.

-B- Filter piping and pipe gallery.

-C- Laboratory

-D- Operating floor: filters, operating platform and table.

-E- Chemical equipment room.

-F- Pump room.

SERVING the progressive West Virginia City of Beckley with a capacity of 2,000,000 gallons per day of purified, sparkling-clear water, this Pittsburgh-Des Moines filtration plant features the use of welded *steel* at every point in the water-handling sequence. Steel is employed for permanence, absolute water-tightness, low maintenance and freedom from cracking or other damage from ground movement or frost. A coat of paint at proper intervals is all that is required to keep the equipment in sound condition for a lifetime.

SEQUENCE OF FLOW

In the Beckley plant, raw water enters through an aerator to a steel mixing chamber provided with mechanical agitation, then flows through two steel spiral baffle sedimentation basins into the steel rapid sand filters (four in number, each with a capacity of 500,000 gallons per day), and then into the steel clear well units—one each of which is built integral with each filter. High service pumps then draw water from the clear wells, delivering it into a one-million gallon capacity reservoir of welded steel, which is located a mile and a half distant from the plant at the high point of the supply main to the city.

OTHER EQUIPMENT

The filter building contains—in addition to the four filter and clear well units—the pump room, chemical equipment room, chemical storage room, laboratory, work room and furnace room. In addition to the two high service pumps, the pump room contains two low service pumps for use during low-water periods at the dam when gravity flow through the system is prevented.

DESIGNED FOR THE FUTURE . . . TODAY!

As the City of Beckley grows, capacity can be added to the filtration plant according to plan, with minimum rearrangement and expense—assuring a continuous water supply of highest quality to the consumer. Thus, Beckley's investment—low in first cost and low in depreciation through economical layout and construction—is designed to return consistent dividends for many years. For a Pittsburgh-Des Moines consultation on the application of a STEEL FILTER PLANT to the water treatment problems of your own municipality, write to the nearest office of this company.

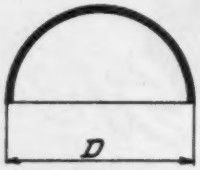
PITTSBURGH • DES MOINES STEEL CO.

PITTSBURGH, PA., 3414 NEVILLE ISLAND—DES MOINES, IOWA, 915 TUTTLE STREET
NEW YORK, ROOM 916, 270 BROADWAY · CHICAGO, 1218 FIRST NATIONAL BANK BUILDING
DALLAS, 1219 PRAETORIAN BUILDING · SAN FRANCISCO, 621 RIALTO BUILDING
SEATTLE, 1122 EIGHTH AVENUE, SOUTH

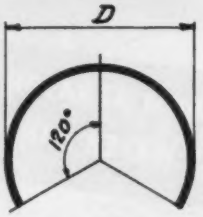
. . . in stock, available for quick delivery

Blaw-Knox STEEL FORMS

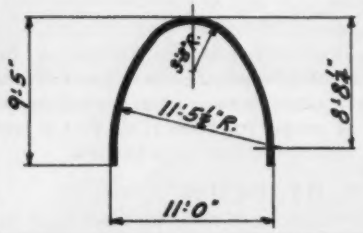
HALF ROUND FORMS
in the following sizes:
D=2'6", 3'6", 4'0", 4'6", 5'0", 5'6", 6'0", 7'0", 8'0", 10'0", 10'6", 12'6", 14'6", 15'0"



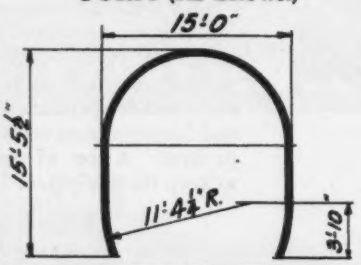
TWO-THIRD ROUND FORMS
Available in 9'0" diameter and 12'6" diameter sizes.



SEMI-ELLIPTICAL FORMS



FORM (As Shown)



These are used forms and are offered subject to prior sale. Complete information regarding them can be secured upon application. Phone, wire or write

BLAW-KNOX DIVISION of Blaw-Knox Company
2001 Farmers Bank Building
Pittsburgh, Pa.

ERIE
BELT DRIVEN DREDGE PUMPS WITH TIMKEN ROLLER BEARINGS

All Thrust Troubles Eliminated
Sizes From 2" to 12"
Write for New Bulletin No. 45
ERIE PUMP & ENGINE WORKS
152 Glenwood Ave. Medina, N. Y.

SASGEN ★ ★ DERRICKS

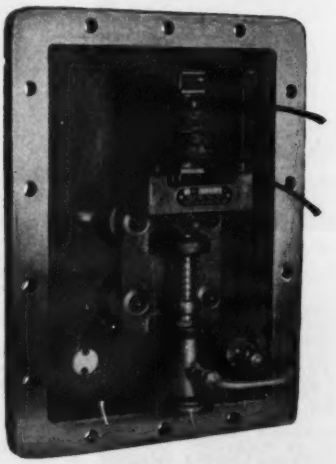
Complete Range of Types and Sizes Get Our Catalog

SASGEN DERRICK CO.
3101 Grand Ave. Chicago, Ill.

in the booths. The booth is designed for use in mills, factories, power houses and other noisy industrial locations.—*Burgess Battery Company, Acoustic Division, 2825 W. Roscoe St., Chicago, Ill.*

New Carrier

A new Ernst Drum and Barrel Carrier designed to handle light wood, fiber, paper barrels and "one-trip" light gage steel containers has been announced. The carrier's capacity is 800 lb. and it will accommodate drums and barrels from 14 in. to 24 in. in diameter. Three-wheel construction automatically balances the load for safer and easier moving of containers. One man can attach the clamp, pull down on the handle, lift the container off the floor a few inches and move it to any distance. Another important feature is the straight, vertical lift of the barrel from the floor to prevent any flowing over of contents from open-head containers.—*Ernst Magic Carrier Sales Company 1456 Jefferson Avenue, Buffalo, N. Y.*



Solenoid-Operated Lubricators

An application of the Bijur solenoid-operated type of automatic lubricator used on machine tools is shown on the

A Really Portable ROCK DRILL..

For Surface Drilling
Holes up to 3 feet deep

- One man operates.
- Uses exhaust to clean holes.
- Takes standard 1 inch hexagon drill rods and detachable bits.

WRITE FOR CATALOG 606

The New Barco Model J-2A Driller WITH EXHAUST BLOWER

This latest addition to the line of BARCO Portable Gasoline Hammers provides a new and economical method for handling the small, scattered rock excavation jobs which occur so frequently and which have been so expensive and troublesome in the past.

•

BARCO MANUFACTURING CO. NOT INC.
1814 Winnemac Ave., Chicago, Ill.

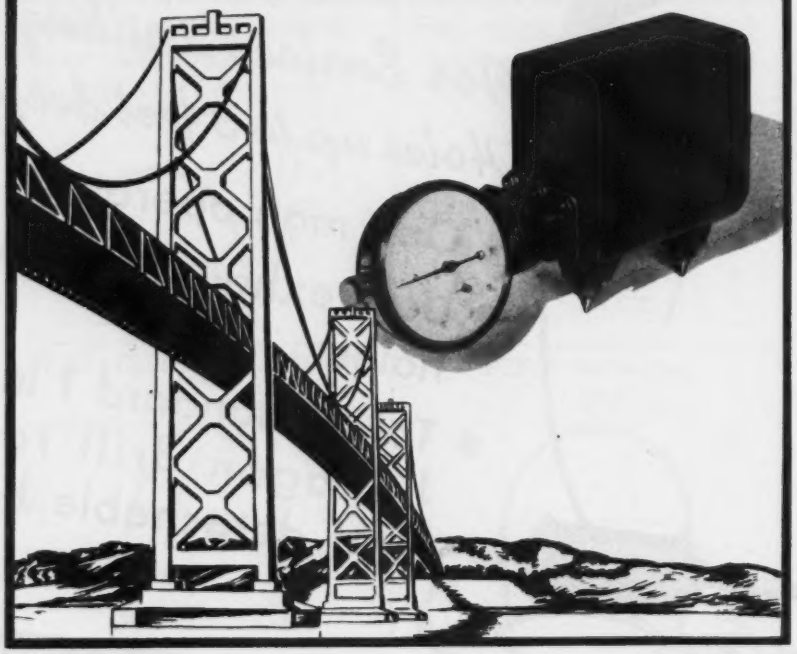
•

BARCO *Portable* GASOLINE HAMMER

CONSERVE MATERIALS

Reduce Costs — Insure Safety

with WHITTEMORE STRAIN GAGES



The cost of engineering structures can be decreased through a more efficient use of material and the elimination of members which do not carry their share of the load. Safety can be insured by determining whether or not computed stresses are in close agreement with actual stresses.

Whittemore hand strain gages are inexpensive—can be used by observers having little training. With these, stresses in each member of a complex structure can be determined at a reasonable cost. Whittemore strain gages—rugged, simple, and accurate—are available in 2-in. and 10-in. gage lengths. Write for Bulletin N-153 describing these and other Southwark strain gages.

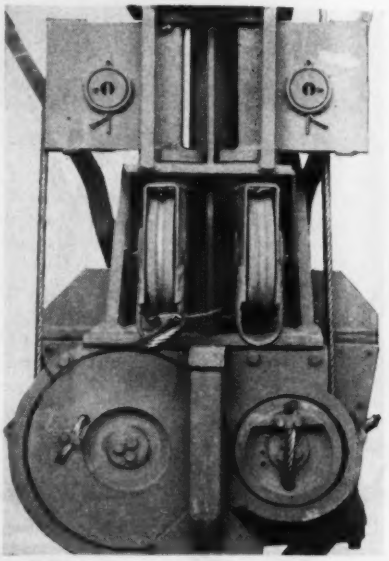
Baldwin Southwark

DIVISION OF THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA

BLW THE BALDWIN GROUP

special RMZ Rotomill shown above, manufactured by the National Broach & Machine Co. The machine is used for facing the ends of tractor crankcases. In the machining, a tractor crankcase is mounted in chucks on the spindles. The milling cutters—which are rotating—advance to the work, make a plunge cut, and the work then begins to rotate on its own centers. A switch, connected to one of the machine slides, energizes the solenoid on the return stroke after completely machining the work. At the end of the return stroke, the current to the solenoid is automatically shut off, the lubricator pump piston descends and oil is delivered through the distribution feedline tubing.—Bijur Lubricator Corp., 43-01 22nd St., Long Island City, N. Y.



Power Control Unit

R. G. LeTourneau, Inc., announces the Model GB4 power control unit for use on D4 "Caterpillar" tractors. This unit, developed primarily for military use, provides a single cable line for Dozer operation from one drum while the other serves as a winch with a line pull of 10,000 lb. The winch drum has a capacity of 265 ft. of ½-in. cable. The GB4 power control unit is more compact and mounts closer to the tractor than most units for small machines, thus making for better tractor balance. The clutch and brake are completely enclosed and run in oil for fast heat dissipation.—*R. G. LeTourneau, Inc., Peoria, Ill.*

Precision Cleaning

A new cleaning process, developed over a period of 12 years, has been announced by the L&R Mfg. Co. Featuring variability for each particular problem confronted, the machines are useful for cleaning of instruments, meters, gages, and related precision mechanisms.—*L&R Mfg. Co., Newark, N. J.*

The answer to a 10 year Prayer!

Says . . . R. D. OWENS
of Owens-Ames-Kimball
Grand Rapids, Michigan
About his MultiFoote
Inclined Boom
Paver!

27-E MultiFoote Inclined Boom Paver owned by Owens-Ames-Kimball speeding another War production factory to completion.

MULTIFOOTE Inclined Boom Pavers are the answer to many a contractor's prayers. Right when most needed, when factories, roads and runways must go up almost overnight, these machines have come into the picture to speed up construction wherever concrete is mixed. They're fast, portable and flexible. You can pour footings, foundations, floors and walls, then move over and pave a road or a runway. Chase them all over a 100 acre lot and back again to mix and pour where you want, when you want *and in a hurry.*

To save time, beat schedules and help to win the War, plan now to put MultiFoote Inclined Boom Pavers to work on your job. Write for details or see your Foote dealer.

THE FOOTE COMPANY, INC., Nunda, New York

27-E and 34-E Single Drum Models!

- *Boom Tilts up to 45 Degrees!*
- *Bucket Hangs Vertically At Any Angle of Boom!*
- *35 Foot Boom!*
- *Standard or Special Buckets!*
- *Boom Swings in 160 Degree Radius!*
- *Easy to Operate!*
- *Fast Bucket Travel!*
- *Rugged, Stable, Trouble-Free!*

Plus all the proved MultiFoote features:

Double cone drum for thorough mixing; No Pressure Water System; Fast skip action; Quarter turn discharge; High operating platform and many other features!

Write for complete facts now.

MULTIFOOTE

Concrete Pavers

STANLEY HARDWARE
—for Rolling or Sliding Doors—

FOR DOORS weighing up to 350 pounds

FOR DOORS weighing up to 700 pounds

FOR DOORS weighing up to 1000 pounds

Stanley Hardware Catalog No. 61 describes the full line. Send for a copy. The Stanley Works, New Britain, Connecticut.

STANLEY
TRADE MARK
HARDWARE FOR CAREFREE DOORS

WILLIAMS *Buckets*

WELDED ROLLED STEEL CONSTRUCTION

All types and capacities for all conditions. Send for Catalog.

THE WELLMAN ENGINEERING COMPANY
7000 Central Ave., Cleveland, Ohio

built by **WELLMAN**

NEPTUNE METER COMPANY
THE WORLD'S LARGEST MAKERS OF LIQUID METERS
1892 . . . 1941
50 West 50th St., New York City
Branches in Principal American Cities and in Canada

Trident Meters

NEW PUBLICATIONS

Steel—The quarterly issue of the U. S. Steel News, published by the United States Steel Corp. places accent on the company's contribution to the war effort. Illustrations and charts give details of production at the company's various plants and the book also contains many personal notes about company employees.—*United States Steel Corp. of Delaware, 436 Seventh Ave., Pittsburgh, Pa.*

Tin—"Tin and Its Uses" No. 12, has been published by the Tin Research Institute and contains an article on the war in the Pacific which states that the present annual supply of tin is about 78,000 tons against a pre-war consumption of 110,000 tons. Other articles include a second interim report on research for improved solder; improvements in the smoothness of tin coatings on tinplate; an account of a temporary exhibition held recently at the National Museum of Wales; tinplating by electro-deposition, and other items.—*The Tin Research Institution, Memorial Institute, 505 King Ave., Columbus, Ohio.*

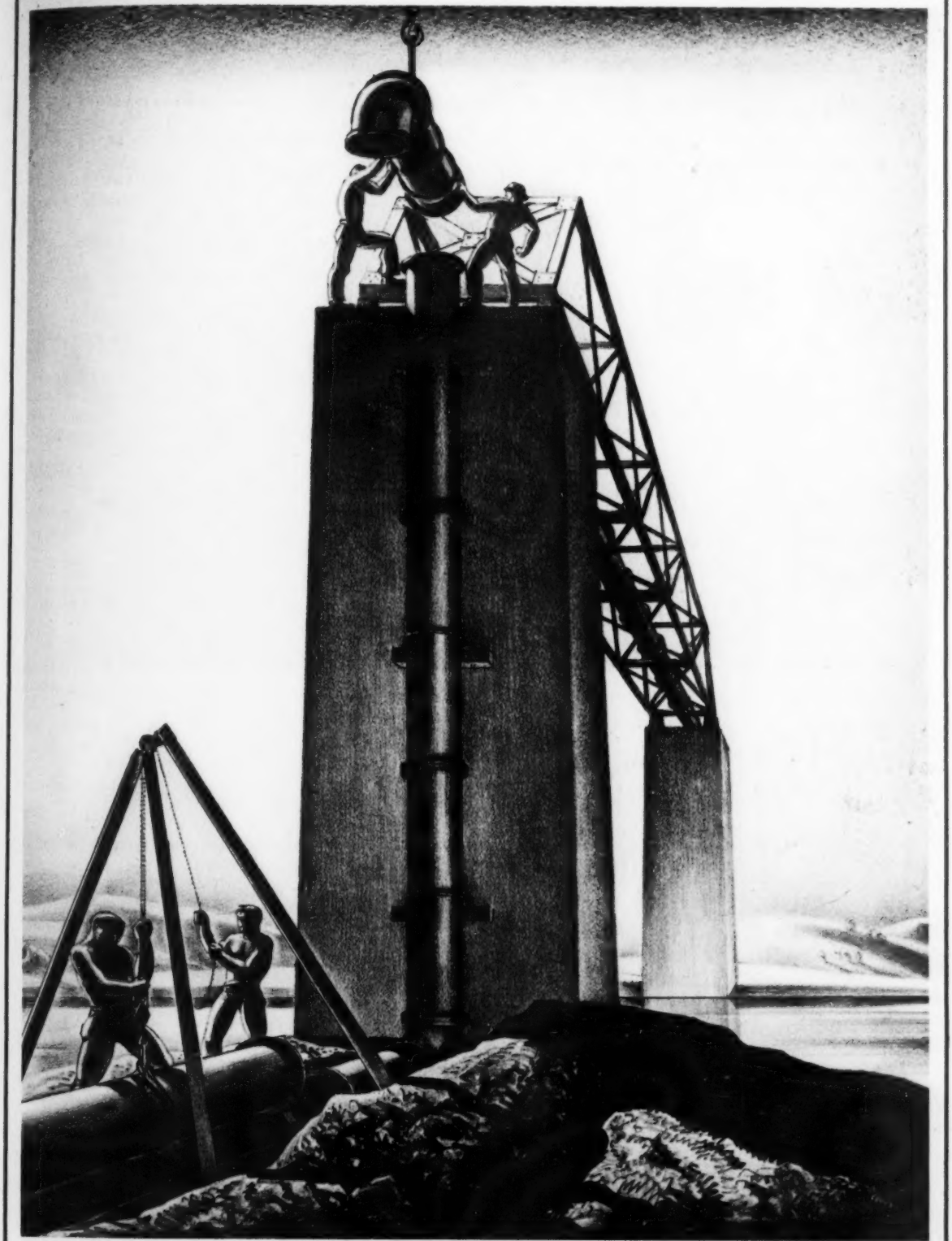
Rollers—A new catalog describing and illustrating new tandem rollers, three-wheel rollers, and Roll-a-Planes has been issued by The Austin-Western Road Machinery Co. This booklet gives dimensions and engineering specifications.—*The Austin-Western Road Machinery Co., Aurora, Ill.*

Copper and Brass—A bulletin showing the many uses to which copper and brass products are being put in the war program has been issued by the Copper & Brass Research Association.—*Copper & Brass Research Association, 420 Lexington Ave., New York, N. Y.*

Cement Gun—The Cement Gun Co. has issued a new bulletin No. 2200, superseding a previous issue describing in detail the performance of use of the company's products, which include "Gunite" and the materials for application of the material. A series of interesting charts and illustrations show many uses for the product.—*The Cement Gun Co., Allentown, Pa.*

Shovels—A bulletin describing its new Model 45¾-yard shovel has been issued by the Bay City Shovel Co. The new machine has a 10-ton crane rating and is said to be of practical size for a great variety of work.—*Bay City Shovels, Bay City, Mich.*

Gloves—A four page catalog section on its electricians' gloves, made by the

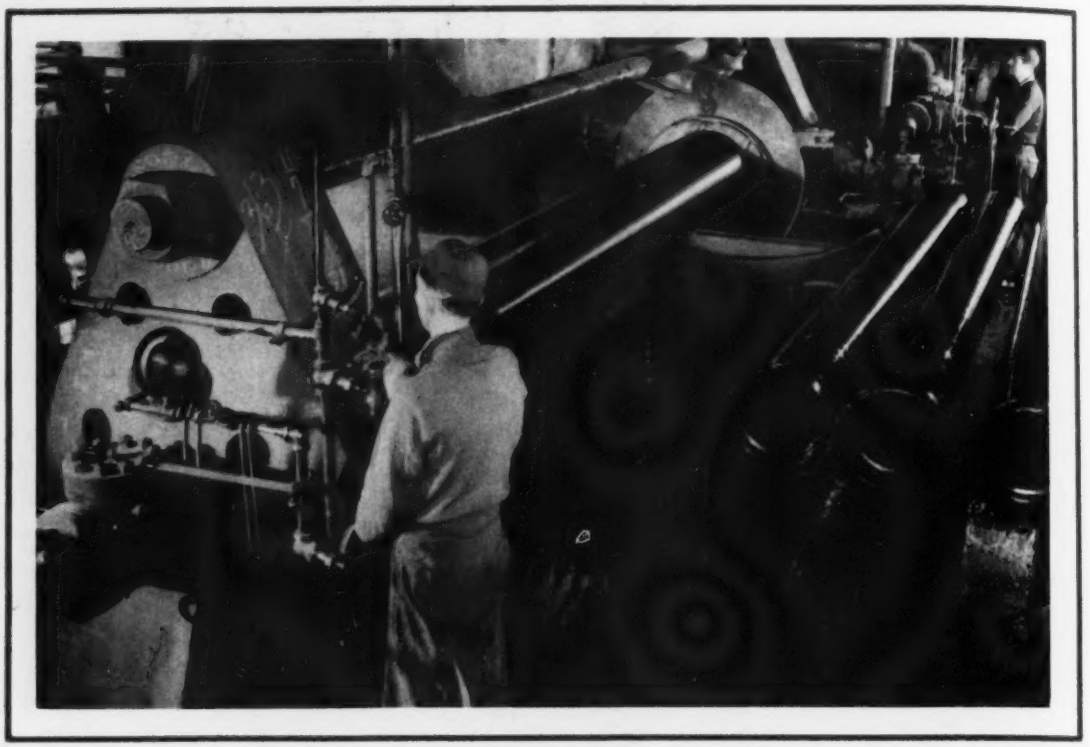


LITHOGRAPHED ON STONE BY ROCKWELL KENT

UNITED STATES PIPE AND FOUNDRY COMPANY

BURLINGTON, NEW JERSEY

America's Largest Producer of Cast Iron Pipe for Water, Gas, Sewerage, Drainage and Industrial Service



* The "Hydrostatic Proof Test," illustrated above, is an acceptance test for cast iron pipe. Every full length of pipe—whether for water, gas, sewer or industrial service—is subjected to this test before shipment. It is one of the routine tests made by this Company to insure that the quality of its pipe meets or exceeds the requirements of accepted standard specifications for cast iron pipe.

* One of a series of controls in operation at each of our plants, beginning with inspection and analysis of raw materials and ending with tests of the finished product, all subject to the central control of our headquarters staff at Burlington.

U.S.
cast iron
PIPE

Centrifugally or Pit Cast for water, gas, sewerage, drainage and industrial services.

Anode process from liquid latex, has just been published by the B. F. Goodrich Co. The catalog section describes the manufacturing process and its advantages, illustrates the type of gloves the company makes, and the rigid tests which have to be passed before the gloves are certified for use.—*The B. F. Goodrich Co., Akron, Ohio.*

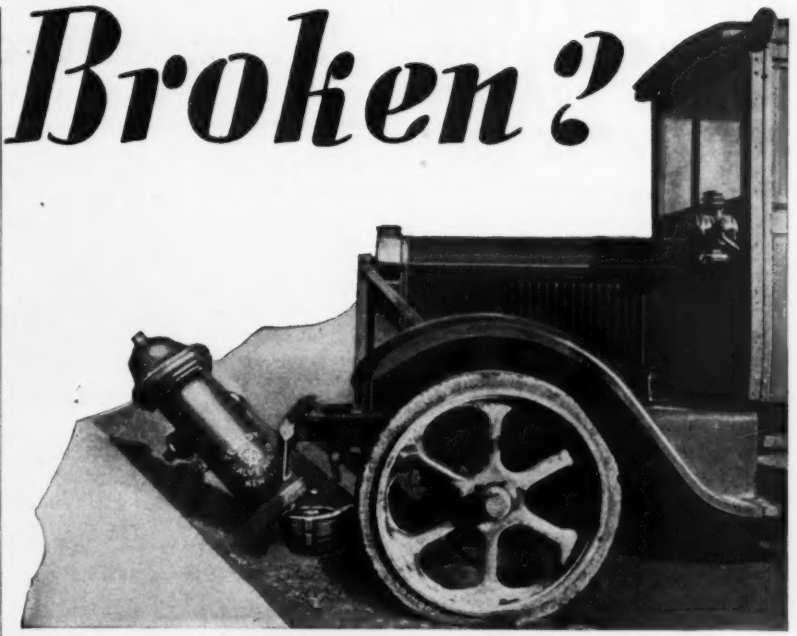
Production Facilities—An interesting and informative new Kirk & Blum catalog "Data on Production Facilities" is aimed at manufacturers who must of necessity subcontract certain sheet metal parts and assemblies. The booklet contains a complete list of machines that comprise the Kirk & Blum facilities for prompt execution of sheet metal, sheet steel, and light plate fabrication. Many illustrations of the various sheet metal parts and large assemblies that have been fabricated under contract are included in the booklet.—*The Kirk & Blum Mfg. Co., Spring Grove Ave., Cincinnati, Ohio.*

Maintenance—A 16-page bulletin 42A, just published by Metallizing Engineering Co., Inc., describes the metallizing process and equipment for its application. It tells briefly how essential industries are eliminating replacements, and increasing service life of equipment now difficult to replace by building up worn diameters with any desired wear, and corrosion-resistant sprayed metal. The catalog also indicates how metallizing is used to rapidly salvage mismachined parts and defective castings in production.—*Metallizing Engineering Co., Inc., 21-07 41st Ave., Long Island City, N. Y.*

Stock Catalog—A new, up-to-date, 16-page catalog listing over a thousand stock items in rheostats, resistors, tap switches, chokes and attenuators has been issued by the Ohmite Mfg. Co. This new catalog, No. 18, is especially useful today to engineers and purchasing departments as a quick reference specification or buying guide. It gives illustrations, descriptions, ratings, prices and other helpful information on the wide range of Ohmite stock types and sizes and simplifies selection thereby.—*Ohmite Mfg. Co., 4835 Flournoy St., Chicago, Ill.*

Center Strip—Keystone Asphalt Products Co. has issued a descriptive data sheet on its new center strip for highway and airport runway construction. The strip, employing asphalt and mineral fillers between two layers of asphalt-saturated liners, was developed to release critical steel normally used for longitudinal joints. Specifications and properties of the product are listed.—*Keystone Asphalt Products Co., 43 E. Ohio St., Chicago, Ill.*

Broken?



If the hydrant is a KENNEDY SAFETOP, repair parts cost only $6.00 and are installed in 15 min.

Kennedy SAFETOP Fire Hydrants, while amply strong to resist ordinary impacts, give way at the Safety Breakable Section if struck in a smashing collision which *no* hydrant could resist.

This design therefore effects striking reductions in breakage repair time and cost, besides eliminating the annoyances and dangers of street floods and interruption to neighborhood water supply.

Kennedy SAFETOPS respond promptly and effectively to service demands at all times. Their large-diameter standpipe and smooth water passages assure full main pressure at the nozzles, and the simple, straight-line, central, positive-acting mechanism operates easily and quickly.

Write for prices and full information

THE KENNEDY VALVE MFG. CO.
ELMIRA, N. Y.

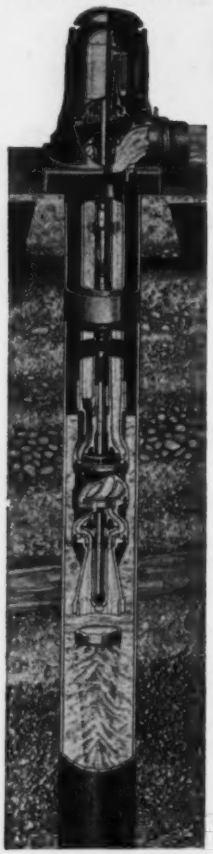
KENNEDY SAFETOP FIRE HYDRANT
REG. U.S. PAT. OFF.

YOU'VE GOT TO GO TO THE BOTTOM TO FIND OUT WHY PEERLESS IS TOPS

From the strainer to the head of a Peerless Pump—bowls, impellers, bearings, shafting, column—all vital parts are built to give you top return on your pumping dollar.

Peerless engineering, research and design give you the most modern improvements in higher sustained efficiencies, widest range of capacities, trouble-free performance and lower operating and maintenance costs.

Peerless popularity gives you the assurance of a life-time of satisfaction, based on knowledge gained from installations in every kind of service.



PEERLESS PUMP

PATENTED DOUBLE SEAL

DOUBLE BOWL BEARINGS

WIDEST RANGE OF CAPACITIES

UP TO 15,000 G.P.M. IN TURBINE TYPES

UP TO 100,000 G.P.M. IN HYDRO-FOIL PROPELLER TYPES

ALL FORMS OF DRIVE

NATIONWIDE SUPER SERVICE

●

Ask for Literature.

Also inquire about the amazing small capacity chrome rotor pump for deep wells.

PEERLESS PUMP DIV.—Food Mach'y. Corp.
301 West Avenue 26 • Los Angeles, California
1250 Camden Avenue S. W. • Canton, Ohio

WATER OR OIL LUBRICATION
Peerless
TURBINE PUMPS

Manufacturer's Activities

Personnel changes and new plans

A Navy "E" award made during the past month was given to HEYL & PATTERSON, INC., contracting engineers of Pittsburgh, Pa., for their production of specialized construction equipment for the Navy. Some of the hammerhead cranes erected by the company, tested to carry loads of about 1,000,000 lb., were built in collaboration with the American Bridge Co. Vice President THOMAS P. BUTLER, of Heyl and Patterson, is shown accepting the Navy "E" burgee on behalf of the company.

C. A. BARABE, sales engineer at the CATERPILLAR TRACTOR COMPANY of Peoria, Ill., has left the company on a leave of absence to accept a commission as a Captain in the Corps of Engineers at Fort Belvoir, Va. A graduate of Purdue University, Captain Barabe joined Caterpillar five years ago after serving as road and bridge engineer for both the Indiana and Illinois state highway departments.

The SOUTHERN MAPPING AND ENGINEERING CO. of which RALPH D. STOUT and FRANK N. PHILLIPS, JR., are partners, has taken over civil engineering work at Greensboro, N. C., recently handled by the late C. S. Kirby.

Recent completion of an eight-story addition to St. Francis Hospital at Peoria, Ill., marks the first use by a hospital of a new system of air conditioning developed by the CARRIER CORPORATION. Outstanding feature of the system is the elimination of sheet metal ducts formerly used to carry air to the spaces to be conditioned. The new type of air conditioning is known as the "Conduit Weathermaster System," and eliminates all recirculation of air.

MARTIN TIERNAN, president of WALLACE & TIERNAN CO., INC. of Newark, N. J., recently presented a check for $6,500 to representatives of the Navy Relief Society of the Third Naval District, on behalf of the employees of his company. The money was raised by the novel method of having each of the 1500 workers voluntarily give one hour of overtime during a week. The value of this work was calculated in terms of finished products, and a sum representing an additional contribution of the company was granted. The program served a twofold purpose, because the finished products

The BRODERICK & BASCOM ROPE CO., manufacturers of wire rope, has been awarded a Navy "E" for excellence and efficiency in war production. Former governor LLOYD C. STARK, and Mayor WILLIAM D. BECKER, of St. Louis, attended the ceremony. JOHN K. BRODERICK, president, accepted the emblem from Capt. EDWIN A. WOLLESON, U. S. Navy, Navy Pier, Chicago.

Still making news

AMONG ARCHITECTS AND ENGINEERS!

Get this latest edition of Toncan Iron Pipe news. Forty-eight pages of editorial and pictorial facts about the advantages of Toncan Iron Pipe—from its qualities as an open-hearth iron to its long life of service under severe corrosive conditions.

Read these authentic facts about Toncan Iron Pipe —why it is made from *open-hearth iron, not* open-hearth *steel*—what this adds to its *rust-resistance,* its easy workability—what *molybdenum* contributes to its grain structure, its uniformity—why Toncan Iron has *twice as much copper* as the finest copper-bearing steel pipe—why this *alloyed* open-hearth iron ranks *first* in corrosion-resistance among all ferrous metals in its price class—and finally, that as an open-hearth iron, copper-molybdenum pipe is included in Federal Pipe Specification WW-P-403a.

When you know these facts—and get them *straight* from a producer of carbon steel, copper-bearing steel and alloy iron pipe—you'll see how you can add to the value of your service, by specifying Toncan Iron Pipe.

Write for a copy of the Toncan Iron Pipe book, 333-R, now. In the meantime, see Sweet's 27/3 on pipe—13/6 on sheets—23/5 on Steel and Tubes —9/1 and 21/2 on Berger—15/18 on Truscon.

REPUBLIC STEEL CORPORATION
General Offices: Cleveland, Ohio
Berger Manufacturing Division • Culvert Division
Niles Steel Products Division • Steel and Tubes Division
Union Drawn Steel Division • Truscon Steel Company

REPUBLIC *Toncan Iron* PIPE

Reg. U. S. Pat. Off.

An alloy of refined open-hearth iron, copper and molybdenum—*that grows old slowly*

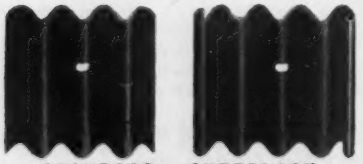
CORRUGATED

. . . GOES IN ON SCHEDULE

Time is money on any construction project. That's why on scores of private, Federal, State and Municipal jobs, Corrugated is used to keep work on schedule.

Light in weight, strong, easy to handle, transport and install; high in salvage value too, Corrugated saves time and money all along the line. It reduces power, labor and transportation costs . . . and, because it can be used and reused, time and time again, its cost per job is cut down to a minimum. On your next job specify Corrugated. Send for specification book today.

CAINE STEEL CO.
1820 N. Central Ave., Chicago



STANDARD INTERLOCK

CAINE
ROLLED STEEL SHEET PILING

are additional materials that go into the war effort. The company employees received a certificate of honor awarded by Frank Knox, Secretary of the Navy.

National distribution of a new booklet emphasizing the need for the strictest conservation of rubber and offering suggestions for motorists on how to extend the life of their tires was started by the B. F. Goodrich Co. last week. Written by John L. Collyer, president, the booklet proposes extensive rubber conservation in the armed forces, a centralized control for all rubber reserves; a national speed limit for the period of the emergency; and careful use of tires and other rubber goods.

Marking its 100th anniversary of existence, the Jos. T. Ryerson & Son Co., Inc. of Chicago, this month looks back over a period which saw its growth from a small "iron store" on the banks of the Chicago River in 1842 to its present enviable position as one of the largest steel service organizations in the world.

From the small store started by Joseph T. Ryerson, the company has grown to a nation-wide service with ten key city plants that measure floor space in acres, spur trackage in miles, and annual shipments in many thousands of tons. Officers of the corporation include Edward L. Ryerson (left), grandson of the founder and present chairman of the board of both Ryerson and Inland Steel, its parent company; and Everett D. Graff, president of the corporation.

Norman Baugh, formerly of the Cook Paint & Varnish Co., has joined the American-Marietta Co. as a technical specialist in Army and Navy Ordnance and Quartermaster Corps paints.

William E. Umstattd was elected president, H. H. Timken, Jr., vice-president and chairman of the board, T. V. Buckwalter, L. M. Klinedinst, and W. Robert Timken, vice-presidents; R. C. Brower, secretary-treasurer, and J. A. Riley, assistant secretary-treasurer at a recent annual meeting of the Timken Roller Bearing Co.

The Copperweld Steel Co. has announced the appointment of N. H. Brodell as metallurgical sales engineer.

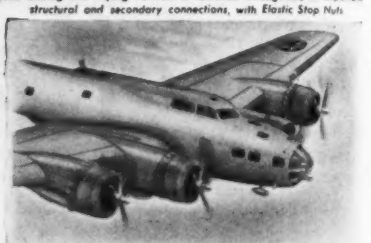
Only JAEGER Pumps Have All These Features

- **JAEGER PRIMING JET** — Up to 5 times faster prime and re-prime — no adjustments, no need to "gun" engine.
- **POSITIVE RECIRCULATION CUT-OFF** — controlled by flow, not pressure.
- **LONG-LIFE SEAL** — Accessible for inspection.
- **PATENTED SELF-CLEANING SHELL**
- **EVERY PUMP FACTORY TESTED** for high capacity and pressure.
- **COMPLETE RANGE OF SIZES, TYPES** — 3,000 to 220,000 g.p.h.

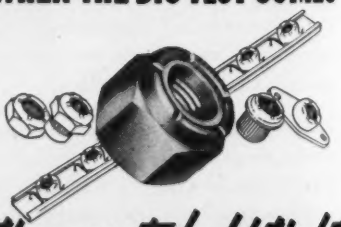
Send Today for Latest Catalog and Prices.

THE JAEGER MACHINE CO
200 Dublin Ave., Columbus, Ohio

The Boeing B-17 Flying Fortress is fastened throughout, at important structural and secondary connections, with Elastic Stop Nuts



WHEN THE BIG TEST COMES



these nuts hold tight

There are more Elastic Stop Nuts on American airplanes, tanks, and other war equipment, than all other lock nuts combined.

» Write for explanatory folder

ELASTIC STOP NUT CORPORATION
2331 VAUXHALL ROAD • UNION, NEW JERSEY

Elastic Stop SELF-LOCKING NUTS

Mr. Brodell, a graduate of Carnegie Institute of Technology, was formerly connected with the TIMKEN STEEL & TUBE DIVISION, Pittsburgh; CRUCIBLE STEEL CORP. and the UNITED ALLOY CORP.

WILEY ELLZEY BROWN, vice president and general sales manager of the CLEVELAND TRACTOR CO., has been granted an indefinite leave of absence to join the army with the rank of major in the Ordnance Department. Maj. Brown has been associated with the company for the last three years.

IRA A. POWELL, 63, of St. Louis, Mo., president of the POWELL ASBESTOS CO., died April 27.

RICHARD D. RAFF was reelected president and treasurer of the DIAMOND PORTLAND CEMENT CO., of Canton, Ohio, at a recent annual meeting. W. W. KINGINER was reelected vice-president; EDWARD H. RAFF was elected secretary, and H. S. HOLLAND reelected assistant secretary.

SAM J. BELL, JR., vice-president of the BELL-LOTT ROAD MACHINERY CO., Columbia, S. C., died April 27.

New buildings and equipment to practically double its production capacity of diesel engines are being erected by the COOPER-BESSEMER CORP. of Mount Vernon, Ohio, at its Grove City, Pa. plant. B. B. WILLIAMS, president, said principal element involved include construction of two new buildings.

WILLIAM FLEMING, JR., president of the SHALER CO. and of its affiliated firms—the NATIONAL RIVET & MFG. CO., and the MIDSTATE MFG. CO.—all of Waupun, Wis., died recently.

NORMAN E. THOMPSON has been appointed assistant general superintendent of the Birmingham, Ala. division of the REPUBLIC STEEL CORP.

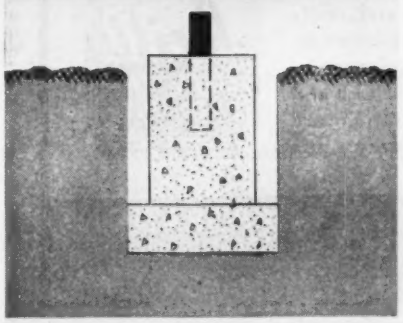
EDWIN J. SCHWANHAUSSER, of Buffalo, N. Y., a vice-president of the WORTHINGTON PUMP AND MACHINERY CORP., has been elected to the corporation's board of directors.

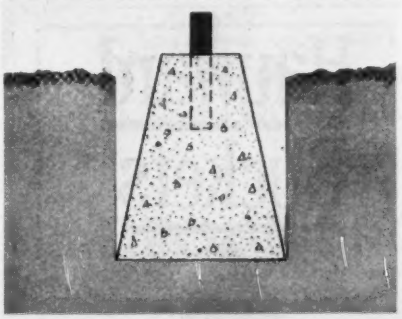
JACOB B. KNABEL, 73, an engineer with the COLUMBIA CHEMICAL DIVISION of the PITTSBURGH PLATE GLASS CO. at Barberton, Ohio, died at his home, April 29th.

At a "Volume for Victory" ceremony in the plant of YOUNG RADIATOR CO., Racine, Wis., F. M. YOUNG, president,

Here's the Unit You Need for
SPEEDY—LOW COST DEFENSE HOUSING WORK!

the* BUDA *EARTH DRILL





• The Buda Earth Drill enables you to figure foundation costs right down to the bone—it assures more foundation footings per hour from existing man power, and guards against costly time penalties.

Drilling holes for pre-cast concrete foundations is one of the many jobs now being handled faster, better, and at lower cost with Buda Earth Drills.

Contractors now using these units report that Buda Earth Drills enable them to correctly place and align footings and piers . . . and to do it faster than by any other method.

Shown at the left are two examples of concrete piers placed by housing contractors. Holes are drilled straight with the Buda Earth Drill, wide enough to accommodate the full bottom width of "anchor" type posts, or tapered blocks, as illustrated. Earth is then back-filled into the open spaces, providing a firm foundation, handled easily and quickly.

Write for complete information and literature.

THE BUDA CO. HARVEY (Chicago Suburb) ILLINOIS

Reilly

Primer and Pipe Enamel

. . . MAINTENANCE COSTS Reduced to the Minimum

The best way to insure low maintenance charges for water, gas and oil pipe lines is to provide *dependable protection against rust and corrosion* due to soil acids and electrolysis. Dependable protection means pipe coatings which bond firmly to the metal, and safely withstand temperature variations without sagging in extreme heat or cracking under severe cold. Such coatings are REILLY PRIMER and PIPE ENAMEL. They are easy to apply, and are comparatively low in cost. Write for literature.

Reilly COAL TAR PRODUCTS

REILLY TAR & CHEMICAL CORPORATION

Executive Offices: Merchants Bank Building, Indianapolis, Indiana

2513 S. DAMEN AVENUE, CHICAGO, ILLINOIS · 500 FIFTH AVENUE, NEW YORK, N. Y. · ST. LOUIS PARK, MINNEAPOLIS, MINN.

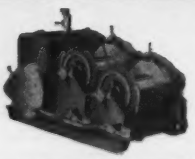
FIFTEEN · PLANTS · TO · SERVE · YOU

STERLING QUALITY

YOU'LL GET BETTER RESULTS WITH STERLING

WRITE FOR LITERATURE

STERLING HOISTS



Simple, Dependable, Rugged—Sterling Hoists, Pumps, Light Plants are the choice of leading users.

STERLING MACHINERY CORP.

405-13 Southwest Blvd. Kansas City, Mo.

Hayward Buckets

Use this Class "E" Clam Shell Bucket for handling crushed stone, gravel, sand and other bulk materials.

THE HAYWARD CO., 48-50 Church St., N. Y.

presented fifteen war savings bonds and victory stamps as the first of a series of awards to be given monthly to employees for meritorious suggestions to speed up war production. Another feature of the program was the award of a President's flag to the department contributing the largest number of meritorious production booster suggestions each month.

WARD BROS. INC., and ORB ROAD MATERIALS, INC., have announced removal of their main office to their asphalt plant on West St., in Haverstraw, N. Y.

WILLIAM G. HOUCK, 70, president and treasurer of the BUFFALO STRUCTURAL STEEL CORP., died on May 4th.

WILLIAM M. BAILEY, chief engineer in charge of industrial and transmitter capacitor divisions, the CORNELL-DUBILIER ELECTRIC CORP., and PAUL M. DOELEY in charge of the chemical laboratories, and the Export Division, have been elected vice-presidents of the corporation.

WILLIAM A. COOK, general manager of READY MIX CONCRETE, LTD., and associated with the company since 1902, died at Montreal, April 18th.

MCCLURE KELLEY, who began his association with the AUSTIN-WESTERN ROAD MACHINERY CO. in 1929 as assistant treasurer, has been elected president of the organization. Mr. Kelley will take office August 1, succeeding SAMUEL F. BEATTY, who becomes chairman of the executive committee on that date.

MELVIN A. THOMSON, vice-president and general manager of the NESBITT, THOMSON & CO., LTD., was elected a director of the INTERNATIONAL BRONZE POWDERS LTD. at an annual meeting held at Quebec recently.

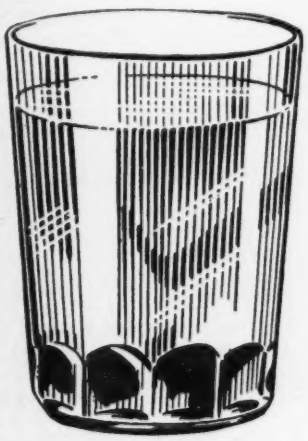
WILLIAM D. REED has recently been appointed general manager of sales for the SAWHILL MFG. CO. of Wheatland, Pa., to supervise the sale of tubular products of all kinds. Mr. Reed, for the past three years, has been connected with the Chicago district sales office of the REPUBLIC STEEL CORPORATION.

HOWARD W. BROECKER, formerly of the YOUNGSTOWN SHEET AND TUBE COMPANY, has been named assistant Chicago district manager for the COPPERWELD STEEL COMPANY.

THE LAPLANT-CHOATE MANUFACTURING CO., Inc., Cedar Rapids, Iowa, has an-

Ozone

PROVES ECONOMICAL AT WHITING, INDIANA



Those who know the water treatment problem at Whiting, Indiana, concede it to be one of the toughest in the United States. The source is Lake Michigan, heavily polluted with industrial and domestic wastes, and getting worse yearly.

It is important that our ozone process, incorporated in the existing filtration plant, now produces a palatable and acceptable drinking water. *It is just as important to the water industry, we feel, that this is accomplished at the very low additional operating expense of only $1.41 per m. g. treated for the entire year of 1941 (with ozone), compared with the full year of 1939 (without ozone).*

The figures have recently been released and are available in our supplement to Bulletin No. 104 entitled "Ozonation at Whiting, Indiana."

Be up-to-date. Let us send you a copy.

OZONE PROCESSES
INCORPORATED
1500 WALNUT STREET PHILADELPHIA, PA
A Member of the Welsbach Group

We Make Over **200** Gasoline Engine Air and Electrically Operated Portable Power Tools and Attachments

with A **Mall** TRADE MARK
GASOLINE POWERED **VIBRATOR** 3 H. P.

- Places low-water-cement-ratio concrete faster, better
- Eliminates honeycombs, voids and expensive hand patching
- Assures a stronger bond with reinforcement
- Permits an earlier stripping of forms
- Variable speed engine runs all day on 1½ to 2 gallons of gasoline
- Operates 8 other interchangeable tools for Concrete Rubbing, Grinding, Sanding, Wire Brushing, Drilling, Pumping, Sharpening Tools and Bits and Sawing with Chain or Circular Saw

Write AT ONCE for full details and ask for a FREE Demonstration

MALL TOOL COMPANY
7730 SOUTH CHICAGO AVE. CHICAGO, ILLINOIS
Offices and Distributors in Principal Cities

KERLOW open STEEL FLOORING

There are four good reasons why Kerlow Open Steel Flooring is used so extensively on bridges and sidewalk openings. **1. Safety** . . . open mesh, non-skid design provides slip-proof footing under all conditions. **2. Light and Ventilation** . . . 85% of the floor area is open. This allows ample passage for light, heat, air and fumes. **3. Permanence** . . . outlasts wood, steel plate or composition floors. **4. Economy** . . . first cost is low, installation is simple and the only maintenance expense is occasional repainting.

Write for bulletin giving complete details.

KERLOW STEEL FLOORING CO. • 23 Mallory Ave., Jersey City, N.J.

nounced the appointment of A. D. DENNIS as secretary-treasurer of the firm. Mr. Dennis was for six years an internal revenue agent, before joining the company.

W. A. SHOUDY has withdrawn from ORROK, MYERS & SHOUDY, Associates, to devote his entire time and service as engineer in charge of the utilities division for the CHEMICAL-CONSTRUCTION CORP., New York City.

NORMAN BAUGHN, associated with the COOK PAINT AND VARNISH COMPANY for the past 12 years, has joined the AMERICAN-MARIETTA COMPANY as a technical specialist in Army and Navy ordnance and quartermaster corps paints.

DAVID W. JENKINS, general sales manager of HENRY DISSTON AND SONS, INC., retired recently, after serving 46 years with the company.

THOMAS WILSON, 87, inventor and former shipbuilding executive, died April 21 in Montreal. He had been for many years associated with the COLLINGWOOD SHIPBUILDING CO. of Collingwood, Ont.

The PENCOYD ENGINEERING CO. INC., has removed its New York Office to 17 E. 42nd Street.

LAWRENCE S. HAMEKER, general manager of the Berger division of the REPUBLIC STEEL CO., Canton, O., since 1934, has been named assistant manager of sales for the corporation.

WILLIAM A. MINKLER has been appointed sales manager of the Catalog Products division of the YOUNG RADIATOR CO. He was assistant sales manager since 1939.

E. A. REAGLE, assistant to the vice-president of the SHARON STEEL CORP., Sharon, Pa., has resigned his post to become vice-president in charge of war production at the INGRAM-RICHARDSON MANUFACTURING CO., Beaver Falls, Pa.

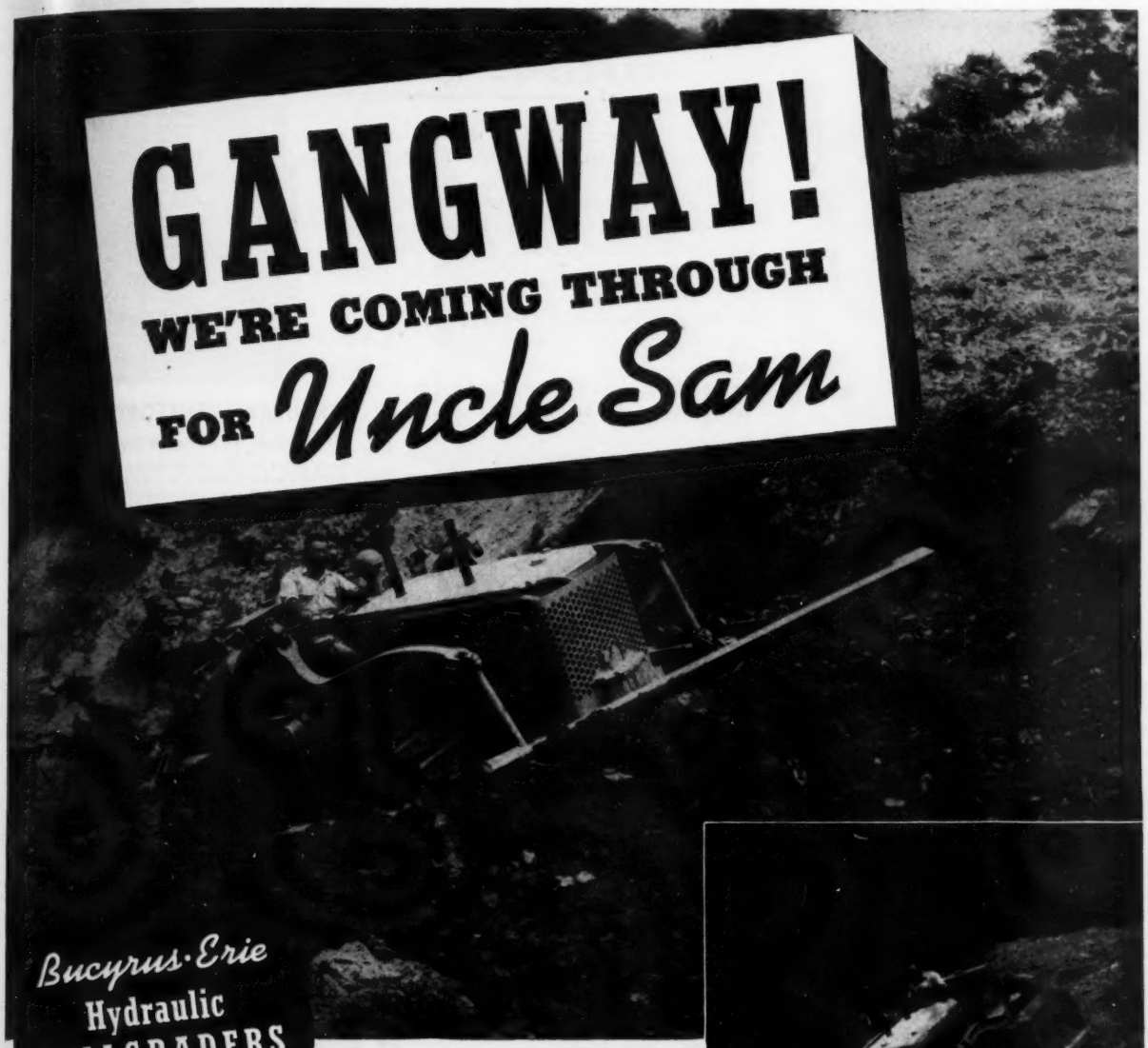
WHEELCO INSTRUMENTS CO. has announced appointment of four new district representatives. PASOL ENGINEERING CO. of Des Moines are named Nebraska and Iowa representatives; FITZGERALD, INC., Wichita, Kans., is assigned the Kansas territory, and CHARLES A. DRUM, Houston, has been named Texas district manager.

UNITED HOISTING CO., INC., has removed its offices and plant to new quarters at 5 West Sheffield Ave., Englewood, N. J.

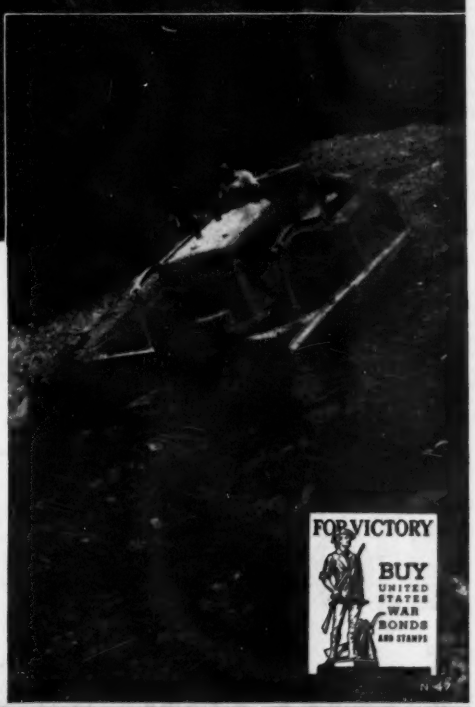
JOHN S. GULLEDGE, St. Louis district manager of the industrial products sales division of the B. F. GEEDRICH CO., has resigned to enter the Army Air Corps.

GANGWAY!

WE'RE COMING THROUGH FOR *Uncle Sam*



Bucyrus-Erie
Hydraulic
BULLGRADERS
and
BULLDOZERS



No tractor power is wasted when Bucyrus-Erie blades dig in . . . that's why they're getting tough, war dirt-moving jobs done ahead of schedule. These units enable the tractor to apply full tractive effort to the blade; relieve overloads on front idlers and other parts of the tractor affected by nose-heaviness . . . because they maintain the tractor's center of balance so that crawlers are always kept full length on the ground. The safe, low pressure hydraulic control system gives the operator positive up-and-down control of the blade for smooth, accurate grading. There is plenty of down pressure behind the blade, too — enough to jack the front end of the tractor off the ground. This means plenty of penetrating power when working in tough materials.
BUCYRUS-ERIE COMPANY, South Milwaukee, Wisconsin.

BUCYRUS ERIE
TRACTOR EQUIPMENT

SEE YOUR
INTERNATIONAL TracTracTor
DISTRIBUTOR

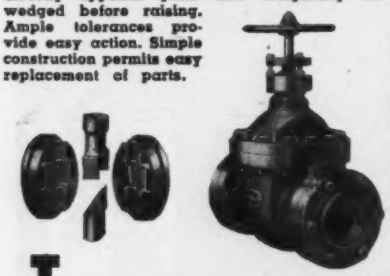
NO MAGIC CARPET BUT...

This blitz buggy can do amazing things! Rugged, compact and always ready for action, it passes the most severe test with colors flying.

The same is true of Ludlow Valves. Today, in vital power plants and manufacturing centers that help sustain our war effort, they're rendering yeoman service . . . taking tough assignments in stride. These rugged valves employ the famous double-disc, parallel seat principle, developed and perfected by Ludlow. This insures smooth operation, tight closure—whether the valve is in action every few minutes or only in emergencies. In peace or war, *Ludlow means value in valves.* Write for Catalog.

THE LUDLOW VALVE MFG. CO., INC.
Troy, New York

Construction Features: Self-releasing 30° angle wedges and free-floating gates, self-adjusting to seats, afford smooth, trouble-free performance, long service. Rings are cleaned throughout stroke action. Gates are wedge-locked directly opposite ports and completely unwedged before raising. Ample tolerances provide easy action. Simple construction permits easy replacement of parts.



LUDLOW VALVES
SINCE 1866

MEETINGS

AMERICAN SOCIETY OF PLANNING OFFICIALS, Indianapolis, Ind., May 24–28.

ASSOCIATED EQUIPMENT DISTRIBUTORS, 23rd semi-annual meeting, Edgewater Beach Hotel, Chicago, Ill., June 8–10.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Spring Board meeting, Stevens Hotel, Chicago, Ill., June 8–9.

AMERICAN WATER WORKS ASSOCIATION, Stevens Hotel, Chicago, June 21–25.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, 50th annual meeting, Columbia University, New York City, June 29–July 2.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, University of Minnesota, St. Paul, Minn., July 22–23.

REGIONAL AND LOCAL MEETINGS

NEW ENGLAND WATER WORKS ASSOCIATION, Manchester Country Club, Manchester, N. H., May, 1942 (Date to be announced).

ILLINOIS ASSOCIATION OF SANITARY DISTRICTS, Decatur, Ill., June 3–4.

ENGINEERING SOCIETY OF DETROIT, annual meeting, Horace H. Rackham Educational Memorial, Detroit, Mich., June 10.

CENTRAL STATES SEWAGE WORKS ASSOCIATION, annual convention, Minneapolis, Minn., June 18–19.

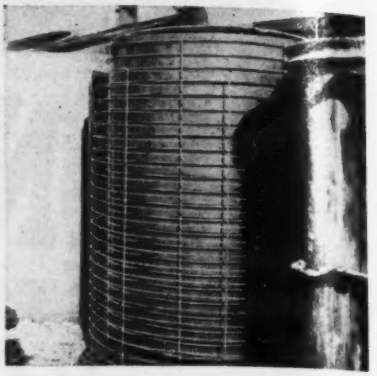
MONTANA ASSOCIATION OF COUNTY COMMISSIONERS, Missoula, Mont., June 23–24.

Elections and Activities

H. C. NICHOLLS, of Toronto, was elected president of the Ontario General Contractors Association at the annual meeting of that group held in Toronto recently. Mr. Nicholls succeeds A. R. Timms, of Welland.

THE spring meeting of the New York State Sewage Works Association will be held at the Hotel Ten Eyck in Albany on Friday and Saturday, June 5-6, 1942.

FEARING that further demands by the War Department on the services of instructors in engineering schools might cripple the training of engineers for war industries, the Southeastern Section of



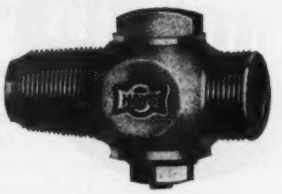
CIRCULAR REINFORCEMENT
The Toughest Test of Welded Fabric Quality

Every step in the manufacture of Clinton Welded Fabric is completed in our own plant. From blast furnace to wire, to electrical welding, it is supervised and tested by our own experts. UNIFORMITY, both in welding and in tensile strength of the wire itself, raises performance standards, and assures maximum strength at welds. Clinton Welded Fabric, the choice of experts for circular and other concrete shapes, comes in sheets or rolls, cut to your *exact* job specifications... saving you the time, trouble, and expense of on-the-job cutting and placing. Wickwire Spencer Steel Company, 500 Fifth Avenue, New York, N. Y.

WICKWIRE PRODUCT

CLINTON REINFORCING FABRIC
It's Electrically Welded
WICKWIRE SPENCER

USE HAYS



IT PAYS

Since 1869 Hays has been making a complete line of quality Water Works Brass Goods for all types of applications "From Street To Bath". Write for catalog.

HAYS MANUFACTURING CO., ERIE, PA.

COPPER • LEAD
BRASS • IRON
HAYS WATER WORKS PRODUCTS
Since 1869

the Society for the Promotion of Engineering Education asked Paul V. McNutt, chief of the War Manpower Commission, for a relaxation in policy. The action was part of the group's annual spring meeting, held at Raleigh and Durham, N. C., May 1 and 2. The resolution, which was included in a message stating that the engineering schools already have gone to the limit in releasing officers on their faculties, asked that the commission defer all such military orders pending an investigation of the condition of the schools. Dr. G. J. Davis, dean of engineering at the University of Alabama, was elected chairman of the group, and other officers named are: Dean Fred Wilkinson of the University of Louisville School of Engineering, vice chairman, and H. G. Haynes of The Citadel, reelected secretary. More than 100 engineering educators from 20 colleges and universities attended the meeting.

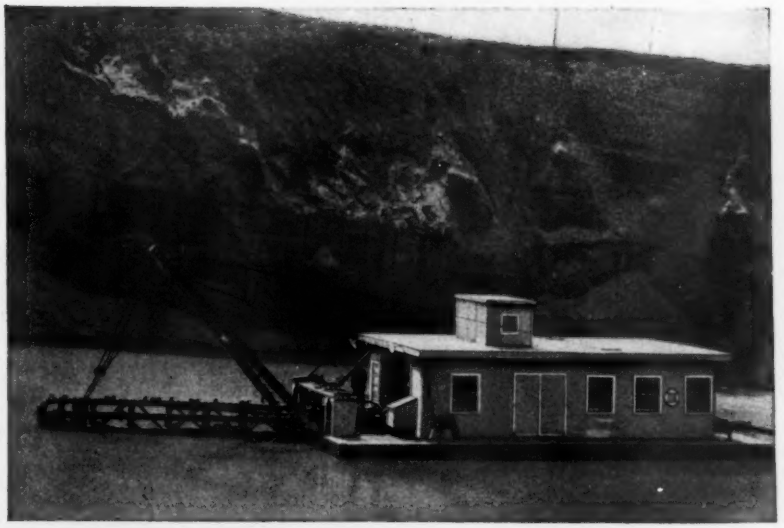
L. B. THRASHER of Ocala, is the new president of the Florida Engineering Society. Other officers elected at an annual meeting at Tampa recently are Edmund Friedman, Miami, first vice president; J. Wylly Keck, Coral Gables, second vice president; J. E. Walker, Ocala, secretary, and Raymond Chase, Jacksonville, treasurer.

THE Carolinas Branch of the Associated Contractors of America has established a "Travel Clearing House" for members of the branch making trips to attend opening of bids. Under the plan several groups may get together and go in one car to conserve tires, gasoline and expense.

STANDARDIZATION in pole line hardware, which will effect economies in manufacturing and stocking expected to be helpful to the war effort, was given final approval by the Pole Line Hardware Committee of the Canadian Engineering Standards Association which held an all-day session recently in Montreal.

PAUL H. EHLERS, consulting engineer of Los Angeles, Cal., recently was elected president of the Engineers and Architects Association of Southern California. Frank L. Cook was elected vice president, Lynn Hirsch was reappointed secretary and full-time office manager, Raymond S. Kidder and Maurice Landau were elected to the board of directors. The group announced that it now has a membership of 985.

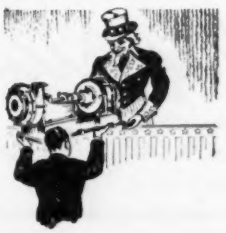
THE University of Tennessee, at Knoxville, was host to a conference on "Trends in Highway Design and Construction," at Ferris Hall on the University Campus May 8 and 9. Speakers at the two day session included William N. Rees, engineer for the Tennessee state highway



The dredge that would not be baffled

It was a hard, compacted deposit . . . but valuable. One sand and gravel producer tried to attack it with his dredge . . . but soon gave it up. Then another producer tried with his dredge . . . and failed. Then another, and another . . . but with equal lack of success. The fifth attempt was made with a Morris Dredge with special equipment recommended by the Morris engineers. The result . . . such complete success that two similar Morris Dredges were later ordered for use in adjacent pits.

This story of Morris Dredges . . . the dredges that will not be baffled . . . has been repeated again and again, all over the country. It is the natural result of the long and extensive experience of the Morris engineers in solving difficult hydraulic dredge and centrifugal pump problems.



WE HAVE ENLISTED "FOR THE DURATION"

We have placed at the disposal of the Government all our facilities that might be of use in the national war effort. But our remaining facilities are at your service, and also the advice of our engineers to help you secure best results from your present equipment and to plan for your future needs.

MORRIS MACHINE WORKS — MORRIS ESTABLISHED 1864 — BALDWINSVILLE NEW YORK

CENTRIFUGAL PUMPS

QUALITY

With A 20 Year Record

The twenty years of making quality tracing cloth behind Arkwright is *your* guarantee of quality today!

Twenty years of testing in Arkwright laboratories . . . of insistence on the highest quality raw materials and the highest standards of manufacture have prepared Arkwright for the present emergency. In spite of the vital need for speed and mass production, you can order Arkwright Tracing Cloths today with the same confidence in quality . . . the same assurance of rapid delivery that has made Arkwright the leading American producer of tracing cloth for twenty years. Arkwright Finishing Company, Providence, R. I.

Arkwright
TRACING CLOTHS

"GUNITE"

can reduce your counstruction costs. It is efficient and dependable, an established product.
WE RECOMMEND "GUNITE" for structural steel protection, floor and roof slabs, thin exterior walls, partitions, tanks, reservoirs, restoring disintegrated concrete surfaces, repairing reinforced concrete, etc.
Let us suggest how "Gunite" can best solve your problems.

PRESSURE CONCRETE CO.
"GUNITE" CONTRACTORS
6 Avenue B Newark, N. J.

The
PHOENIX BRIDGE CO.
BRIDGES and BUILDINGS
General Office and Works
Phoenixville, Pa.
District Offices
New York, N. Y. Boston, Mass.
Washington, D. C.

department; Harry Wiersema, TVA engineer; N. W. Dougherty, dean of engineering at the School; Dr. James D. Hoskins, University president; C. W. Phillips, commissioner of the Tennessee state highway department, and Senator James P. Pope, director of the TVA.

THE South Carolina section of the American Institute of Electrical engineers at a recent meeting in Charleston heard F. E. Lieb, of the engineering department of the Copperweld Steel Co., speak on "Practical Considerations in Electrical Grounding." The group made a tour of the Santee-Cooper project as a part of the session.

THE annual summer joint session of the Wisconsin County Highway Commissioners' Association and the Wisconsin County Highway Committee Members' Association will be held at Chippewa Falls June 16-18.

FRANCIS B. MCGARRY, city manager of West Palm Beach, was elected president of the Florida City Managers' Association at an annual convention held in Orlando recently. Other officers named were: A. B. Curry, Miami, vice president; R. B. Merserve, Fernandia, secretary and treasurer.

D. S. ABELL, chief sanitary engineer and director of the Bureau of Sanitation of the Alabama Department of Health was elected vice-president of the Southeastern section of the American Waterworks Association, at an annual meeting in Atlanta, Ga., recently. The group presented W. D. Moore, president of the American Cast Iron Pipe Company of Birmingham, Ala., with the George W. Fuller award for service to the waterworks profession and municipalities.

SOUTHERN Illinois Water Works Operators held their 11th annual meeting May 12 at Carbondale. The meeting featured discussion of emergency water supply problems and of emergency wartime repairs for water systems, the discussion sponsored by the State Department of Public Health, Division of Sanitary Engineering.

J. A. MCCRORY, vice president and chief engineer of the Shawinigan Engineering Co., Ltd., Montreal, was elected president of the Corporation of Professional Engineers of the Province of Quebec, at an annual meeting held in Montreal. Other officers elected included: A. O. Dufresne, deputy minister, Department of Mines, vice president; C. C. Lindsay, consulting engineer of Montreal, secretary-treasurer; Brian R. Perry, Montreal, J. Omer Martineau, Quebec, P. E. Poitras, Montreal, A. D. Ross, Montreal and Adhemar Laframboise, Quebec, counselors.

Bigger ~~BIG~~ PAY LOADS with the New #3½ Smith-Mobile!

May be mounted on relatively light, 2-axle truck, if desired.

9 CU. FT. GREATER DRUM VOLUME

165 cu. ft. drum volume of No. 3½ Smith-Mobile permits bigger payloads.

...and yet Smith-Mobile WEIGHS LESS

More Profit Per Load!

Now — you can mix and deliver more concrete on every trip by using the new No. 3½ Smith-Mobile Truck Mixer. It has a drum volume of 165 cu. ft. . . . *nine cubic feet more than competitive 3-yard mixers.* This additional pay load capacity gives ready-mixed concrete operators EXTRA PROFITS with every load. In spite of this big feature, the new No. 3½ Smith-Mobile weighs less than competitive 3-yard machines. Actually, it does NOT require the 6-wheel truck shown in the illustration above, except for unusual load or ground conditions. A relatively light, 2-axle truck is usually all that's needed.

Then consider Smith-Mobile's many other features: HIGH DISCHARGE without hoist . . . CONTROLLED DISCHARGE without segregation . . . VISIBLE MIXING . . . FEED CHUTE CHARGING . . . etc., *the ONLY truck mixer with all these features.* Be sure to get your copy of the new Smith-Mobile Catalog No. 198-B.

THE T. L. SMITH CO. 2855 N. 32nd St., Milwaukee, Wis.

SMITH

SMITH-MOBILE *The Original High-Discharge* TRUCK MIXER & AGITATOR

FOR VICTORY BUY WAR BONDS

FOR DEPENDABILITY
WAR PLANTS ARE BUYING

★SMITH EQUIPMENT

FOR AIRPORTS, MUNITIONS PLANTS, ORDNANCE PLANTS, CAMPS

Every effort will be made to take care of regular customers. In the meanwhile, get catalog and plan for greater economy in water control.

THE A. P. SMITH MFG. CO.

7 So. Dearborn St., Chicago, Ill.
409 Texas St., El Paso, Texas
315 N. Crescent St., Flandreau, S. D.
901 Wm. Oliver Bldg., Atlanta, Ga.
59 Oak Vale Ave., Berkeley, Calif.
524½ First Ave. S., Seattle, Wash.

Extra *power* for tandem rollers — with LE ROI Engines

. . . typical of construction equipment Le Roi-equipped for dependable, trouble-free service

Big-machine power — compactly fitting into small-machine design. That's what C. H. & E. Mfg. Co., Milwaukee, Wis. needed for their tandem rollers. And that's what they found in Le Roi Engines. • They bought their first Le Roi in 1920 — and they're still buying them today, for a variety of CH&E equipment. Ample proof that CH&E users enjoy the power performance they expect. • Perhaps Le Roi Engines can add extra satisfaction as original equipment on *your* machines. Learn more about them. Look for them when you buy machinery . . . Write us about your requirements so that we can send you helpful information.

E-10

LE ROI COMPANY • MILWAUKEE, WISCONSIN

MEN AND JOBS

William Hasfurther, senior sanitary engineer of the industrial waste section, Illinois State Division of Sanitary Engineering, at Springfield, left his post May 19 to join the Sanitary Corps of the Army at Indianapolis, Ind. Six other engineers of the division also entered military service recently. They include: **Walter Reiger,** district sanitary engineer at Freeport; **Jack Sieg,** district sanitary engineer, Macomb; **Thomas Philbin,** district engineer, LaSalle; **William Honsa,** district engineer at Paris; **George Farnsworth,** district engineer at Woodstock and **Raymond Leland,** assistant district engineer, Freeport.

David P. Clifford, superintendent of the Dunn, S. C., city water department, has been commissioned a First Lieutenant in the Army Sanitary Corps.

John N. Edy, an engineering graduate of the University of Missouri, and formerly chief engineer of the Montana Highway Department, has been appointed executive assistant to the commissioner of the Federal Public Housing Authority.

George Genningsen of Storm Lake, Ia., has been named engineer for Jones County with headquarters at Anamosa. He succeeds **Charles Spaethe** of Anamosa, who expects to join the U. S. Army Air Corps soon.

W. R. Bringolf, bridge engineer for the Public Roads Administration, at Missoula, Mont., has left to do work on the new Alaska highway. **John Zoss** of Portland will succeed Mr. Bringolf at Missoula.

Robert Gaston of Grundy Center, assistant county engineer for Grundy County, (Ia.) has resigned to accept a post with Stanley Engineering Co. of Muscatine.

Floyd Rubey, Clarinda, Ia., county engineer for Page County, has been elected president of the Southwestern Iowa Engineers' Club.

A. F. Greaves-Walker, head of the Ceramics Engineering Department of North Carolina State College, has been retained by the North Carolina Highway and Public Works Commission to study possibilities of mining a limestone deposit in Yadkin County.

Maj. Daniel P. Caulkins, area engineer in charge of construction of an army technical school near Springfield, Mo., has been transferred to Salina, Kans. to supervise construction of a large army

cantonment near that city.

Howard Potter, a member of the firm of Caldwell Engineering Co., of Jacksonville, Ill., recently was commissioned a Lt. Commander in the Navy.

John D. Johnson has been appointed superintendent at the Erie (Pa.) Water Bureau, succeeding the late James S. Dunwoody. Mr. Johnson was formerly assistant superintendent.

Henry W. DeSaussure, Jacksonville, Fla., consulting engineer, has been commissioned a Major in the Corps of Engineers.

Gerard H. Matthes, head engineer, Mississippi River Commission, has been assigned to the duties of director, U. S. Waterways Experiment Station, Vicksburg, Miss. He will continue to act as consultant to the president of the River Commission.

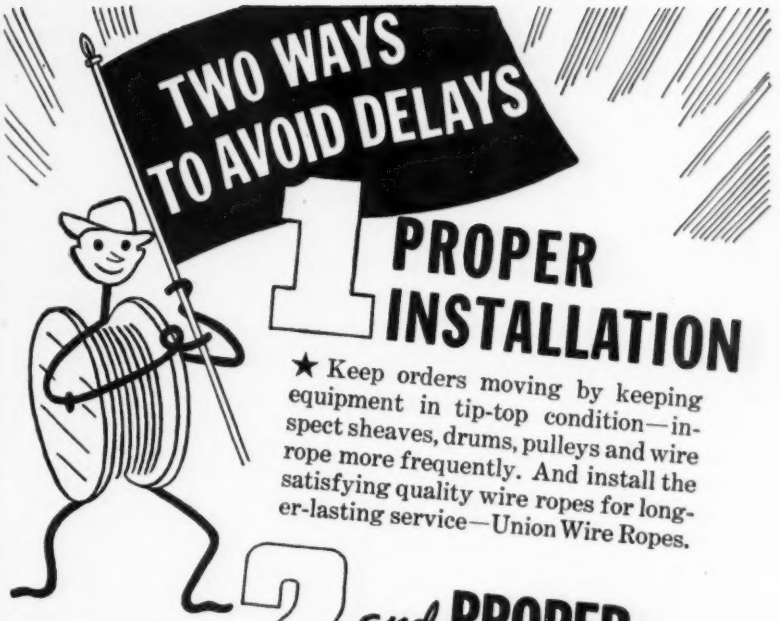
Charles E. Ferris, head of the Industrial Engineering Department at the University of Tennessee, has resigned his faculty post after 50 years of service. The Engineering Building on the campus bears his name.

Changes in the Michigan State Highway Department chiefs of division, due chiefly to division consolidations, were announced recently by **G. Donald Kennedy,** state highway commissioner. **Leonard C. Sauer,** formerly director of the Office Management Division, has been named administrative assistant. **Mott B. Heath,** formerly director of public relations, and **M. J. Walker,** formerly assistant road engineer, are now assistant directors of the administrative division. **J. G. Schaub** has been appointed assistant chief engineer and remains in charge of construction and operations. **A. F. Malo,** formerly traffic and safety engineer, has been made assistant road engineer in charge of design.

George Covert, delta district engineer for the Mississippi State Highway Department, has resigned to join the Corps of Engineers. **Claude Davidson,** assistant district engineer, has succeeded Mr. Covert.

Herbert F. Coupe, formerly with the Saguenay Power Co., Ltd., is now an engineer with the Aluminum Co. of Canada, Ltd. on construction of a storage dam on the Peribonka River, north of Dolbeau, Que.

Donald Vandercook, formerly of the Austin Co. and **J. G. Wray** and **E. W. Ballard** have formed the consulting engineering firm of Equipment Engineering Associates, Chicago. They will spe-

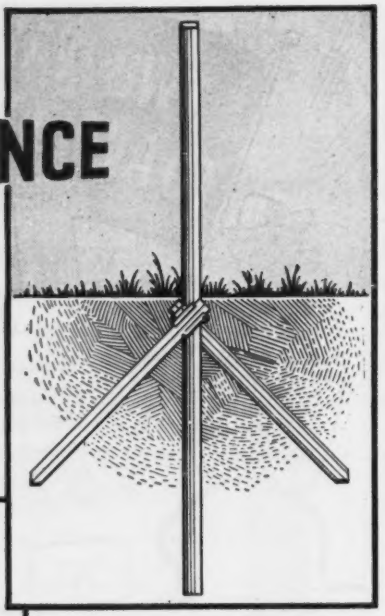

TWO WAYS TO AVOID DELAYS
1 PROPER INSTALLATION
★ Keep orders moving by keeping equipment in tip-top condition—inspect sheaves, drums, pulleys and wire rope more frequently. And install the satisfying quality wire ropes for longer-lasting service—Union Wire Ropes.
2 and PROPER UNION WIRE ROPE
★ There is a Union Wire Rope to fit every service requirement—correctly and economically. See the Union Wire Rope man in your territory for a full analysis of your equipment needs. Or write for complete information.
UNION WIRE ROPE CORPORATION
2134 Manchester Ave. Kansas City, Mo.
Tulsa • Houston • Chicago • Salt Lake City
New Orleans • Monahans • Portland • Ashland, Ky.
UNION Wire Ropes
The "ULTIMATE LOW COST WIRE ROPE"
WRITE FOR ROPE DOPE
This educational wire rope bulletin will be mailed to you without charge.
5-42

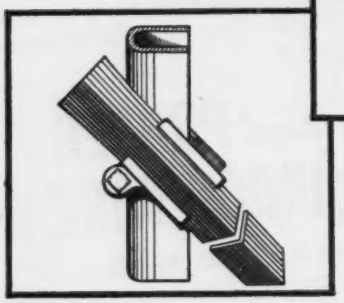
BRITTIN BRACKETS SAVE MONEY
in building SCAFFOLDS —HORSES
Dismantled by slipping legs out of bracket.
Minimum storage and drayage. Bracing unnecessary—set up quickly—strong—safe—guaranteed.
Your demands promptly fulfilled.
EDWARD B. BRITTIN
412 So. 7th St., Res., Springfield, Ill.
5420 Connecticut Ave., Washington, D. C.

Why ANCHOR FENCE

STANDS RIGID IN ANY SOIL!

with exclusive, patented "DRIVE ANCHOR" POST FOUNDATIONS





Posts and anchors are *driven* deep into the solid sub-soil. The angle-shaped anchors extend at right angles to the fence-line, and are clamped to the post to form a *three-point* "tree-root" anchorage. Strain severe enough to bend the posts will not shift the anchorage.

The first chain link fence in America, installed by Anchor in 1907 with "drive anchor" post foundations, is still erect and in line, solid despite the years. Your fence can be installed with exclusive "drive anchors" in *any* weather, in any soil, even in frozen ground. In case of plant expansion the fence can be moved without loss of post foundations. Get facts about "drive anchors." See how they give extra protection, long life, low maintenance costs. Write for Catalog, and name of nearest Anchor Fence Engineer. Anchor Post Fence Co., 6665 Eastern Avenue, Baltimore, Md.

1892 - 1942
Fifty Years of Service

Nation-Wide Sales and Erecting Service

BAILEY METERS AND CONTROLLERS

FOR SEWAGE TREATMENT AND WATER SUPPLY . . .

● Venturi Tubes, Weirs, Flumes, Nozzles and other primary elements; Mechanically and Electrically operated Registers and Complete Automatic Control Systems.

BAILEY METER COMPANY
1829 IVANHOE ROAD • CLEVELAND, O.
Bailey Meter Co. Ltd., Montreal, Canada

We Look Into the Earth

● By using Diamond Core Drills we prospect Coal and Mineral Lands. We are fully equipped for testing foundations for bridges, dams, buildings, and all work of a similar character.

PENNSYLVANIA DRILLING CO.
Drilling Contractors
PITTSBURGH - - - - PA.

cialize in electrical and mechanical design and installation and industrial plant layout.

Maj. Jasper Samuel Utter, who formerly was a civil engineer at Hamlet, N. C., has been assigned to the Wellston Air Depot at Robins Field, near Macon, Ga.

John H. Thompson, of Kansas City, Mo., highway engineer for Jackson County, has obtained a leave of absence to take up active duty as a lieutenant in the Corps of Engineers.

Claude A. Renshaw, City Manager, has been appointed acting city engineer of Miami Beach, Fla., taking over the duties of Morris N. Lipp, who was given a leave of absence to serve in the Corps of Engineers.

Ben F. Renfro, construction engineer in charge of PWA projects in Fort Worth, Arlington and Weatherford, Tex., has been appointed regional office manager in Fort Worth.

John M. Anderson, of Ames, Iowa, has been appointed field engineer in Minnesota for the Structural Clay Products Institute.

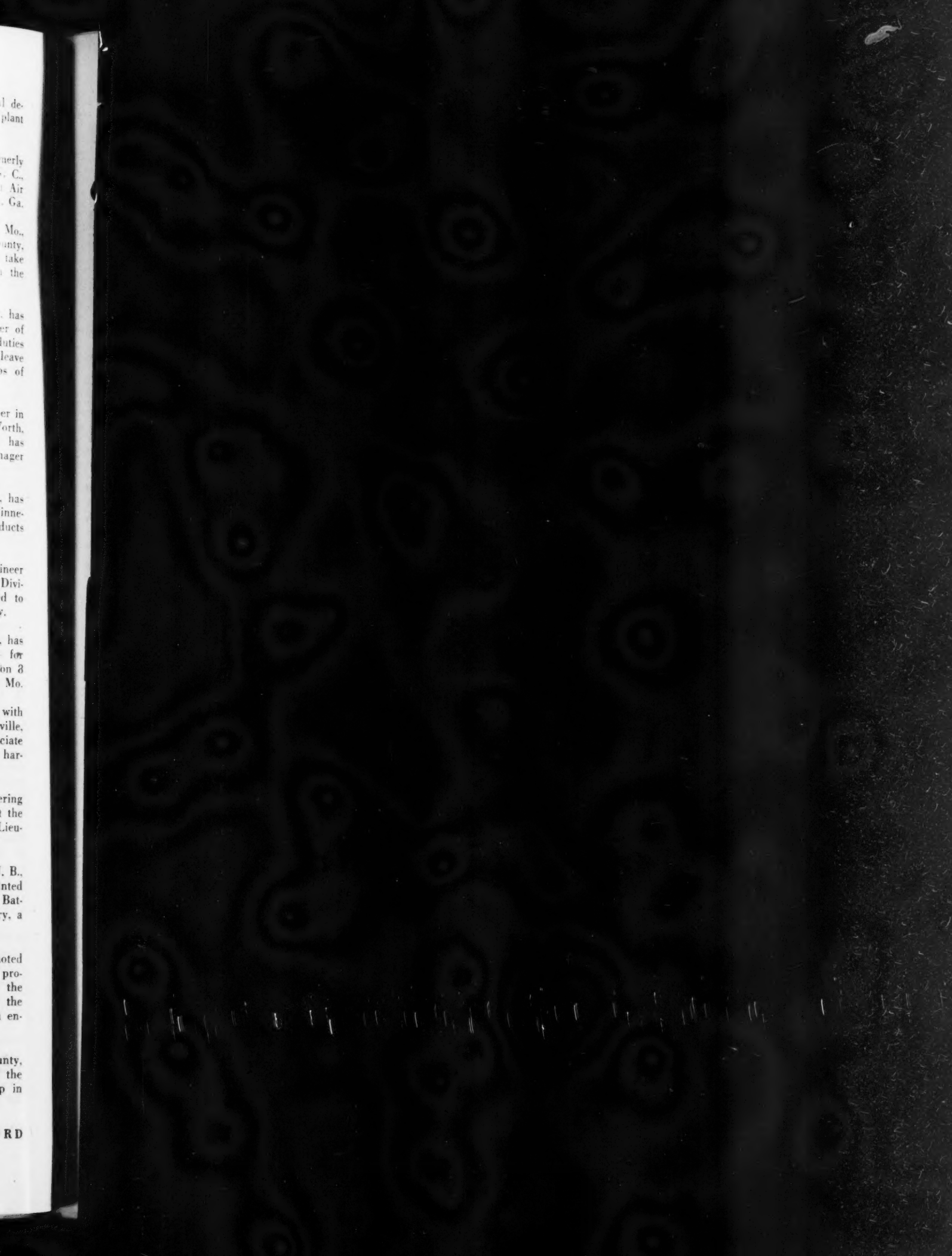
R. L. Gardner, junior highway engineer of the bridge section, Illinois State Division of Highways, has been called to active service with the U. S. Army.

George A. Beib of St. Paul, Minn., has been appointed regional engineer for the Federal Works Agency in Region 3 with headquarters at Kansas City, Mo.

Harold A. Scott, assistant engineer with the Corps of Engineers in Jacksonville, Fla., has been promoted to associate engineer in flood control, river and harbor work.

Don L. Stevens, director of engineering personnel at Iowa State College, left the college recently to become a First Lieutenant in the Army Air Corps.

Capt. L. C. D. Otty of Dalhousie, N. B., a civil engineer, has been appointed commander of the 103rd Anti-Tank Battery of the Royal Canadian Artillery, a new unit.

Gilbert H. Dunstan has been promoted from assistant professor to associate professor of sanitary engineering at the University of Alabama, supervising the course in sanitary and public health engineering.

Chester Canham, Williamson County, Ill. engineer, is engineer on one of the first two county health units set up in Illinois, near Carbondale.